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BRITISH STANDARD 368 : 1956

U.D.C. 625.882: 666.977

**PRECAST
CONCRETE FLAGS**

BRITISH STANDARDS INSTITUTION

BRITISH STANDARD SPECIFICATION

PRECAST CONCRETE FLAGS

B.S. 368: 1956

Incorporating amendment issued April 1963 (P.D. 4896)

Price 4/- net

BRITISH STANDARDS INSTITUTION

INCORPORATED BY ROYAL CHARTER

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THIS BRITISH STANDARD, having been approved by the Cement, Lime and Gypsum Industry Standards Committee and endorsed by the Chairman of the Building Divisional Council, was published under the authority of the General Council on 2 February, 1956.

First published August, 1929.

First revision May, 1936.

Second revision January, 1956.

The Institution desires to call attention to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over 4000, indexed and cross-indexed for reference, together with an abstract of each standard, will be found in the Institution's Yearbook, price 15s.

This standard makes reference to the following British Standards:—

- B.S. 12. Portland cement (ordinary and rapid hardening).
- B.S. 146. Portland blastfurnace cement.
- B.S. 410. Test sieves.
- B.S. 915. High alumina cement.
- B.S. 882. Coarse and fine aggregates from natural sources.
- B.S. 1014. Pigments for colouring cement, magnesium oxychloride and concrete.
- B.S. 1047. Air-cooled blastfurnace slag coarse aggregate for concrete.
- B.S. 1201. Aggregates for granolithic concrete floor finishes.

British Standards are revised, when necessary, by the issue either of amendment slips or of revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or editions.

The following B.S.I. references relate to the work on this standard:—
Committee reference CEB/6/4 Draft for comment CV(CEB)2506

CO-OPERATING ORGANIZATIONS

The Cement, Lime and Gypsum Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives of the following Government departments and scientific and industrial organizations:—

- Admiralty
- Air Ministry
- *Association of Consulting Engineers (Incorporated)
- *Ballast Sand and Allied Trades Association
- *British Cast Concrete Federation
- *British Granite and Whinstone Federation
- British Railways, The British Transport Commission
- *Cast Stone and Concrete Federation
- *Cement and Concrete Association
- *Cement Makers Federation
- Chalk Lime and Allied Industries Research Association
- Chalk Quarrying Association
- *D.S.I.R.—Building Research Station
- Federation of Civil Engineering Contractors
- Gypsum Building Products Association
- Imperial Chemical Industries Ltd.
- *Institution of Civil Engineers
- *Institution of Municipal Engineers
- *Institution of Structural Engineers
- Institution of Water Engineers
- *Limestone Federation
- London County Council
- London Transport Executive, The British Transport Commission
- Ministry of Housing and Local Government
- *Ministry of Transport & Civil Aviation
- Ministry of Works
- *National Federation of Building Trades Employers
- Reinforced Concrete Association
- *Royal Institute of British Architects
- Royal Institution of Chartered Surveyors
- Southern Lime Association

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:—

Associated Paving Manufacturers
 Associated Portland Cement Manufacturers Ltd.
 County Surveyors Society
 D.S.I.R.—Road Research Laboratory
 National Physical Laboratory
 Roads Improvement Association
 South-Western Roadstone Employers Federation
 War Office

BRITISH STANDARD SPECIFICATION FOR PRECAST CONCRETE FLAGS

FOREWORD

This British Standard, which was first issued in 1929, revised in 1936 and amended in 1947, has been reviewed again in the light of present day practice in the manufacture of concrete flags under the authority of the Cement, Lime and Gypsum Industry Standards Committee. Whilst it has been found generally satisfactory, it was considered that assistance would be given to both the purchaser and manufacturer in the choice of aggregates if reference was made to the appropriate clauses of British Standards for such aggregates. This will enable the purchaser to quote a British Standard where possible.

Where the purchaser or the manufacturer wishes to use an aggregate not so provided for, it must be emphasized that one of the requirements of this British Standard is that the purchaser shall approve the aggregate, the interests of both purchaser and manufacturer being protected thereby.

Amendments have also been made where possible to secure uniformity with B.S. 340 'Pre-cast concrete kerbs, channels, edgings and quadrants'.

The omission of specific manufacturing details has again been considered. No reason could be found for departing from the decision made at the last revision, not to include detailed requirements for the manufacture of the flags but to leave the purchaser to state his requirements.

SPECIFICATION

SCOPE

1. This British Standard covers precast paving flags manufactured from a concrete mixture in a range of sizes and thicknesses for use in the construction of footways to roads and other paved areas.

CEMENT

2. The whole of the cement used in the manufacture of the paving flags shall comply with one of the following British Standards:—

- B.S. 12. Portland cement (ordinary and rapid hardening) or
- B.S. 146. Portland blastfurnace cement.

When specially ordered by the purchaser cement complying with B.S. 915 'High alumina cement', or sulphate resisting Portland cement complying with all the requirements of B.S. 12, may be used.

AGGREGATES

3. *a. Quality.* The aggregate or mixture of aggregates shall be approved by the purchaser and no variations or additions to an agreed aggregate shall be made without the consent of the purchaser.

The aggregate shall consist of either naturally occurring materials, crushed or uncrushed, of a quality covered by Clause 3 of B.S. 882 'Coarse and fine aggregates from natural sources' or Clause 3 of B.S. 1201 'Aggregates for granolithic concrete floor finishes', or air-cooled blast-furnace slag complying with Clause 5 of B.S. 1047, 'Air-cooled slag aggregate for concrete.'

Any additional material required to produce special properties such as a special texture, colour or grip shall not have any deleterious effect upon the concrete.

b. Grading. When sampled and tested by the methods described in B.S. 812 'Sampling and testing of mineral aggregates, sands and fillers', the grading shall be such that not less than 95 per cent of the aggregate passes a $\frac{3}{8}$ in. B.S. *test sieve and none shall be retained on a $\frac{1}{2}$ in. B.S. test sieve.

COLOUR

4. Unless otherwise specified by the purchaser the flags shall be supplied in natural colour. When flags are ordered coloured, the colour shall be agreed by the purchaser, and the pigments used shall comply with the requirements of B.S. 1014, 'Pigments for colouring cement, magnesium oxychloride and concrete'. Alternatively pre-coloured Portland cement may be used.

The purchaser shall state whether the colour is to be throughout the flag or whether it is required only in a surface layer. In the latter case the surface layer shall be not less than $\frac{1}{2}$ in. thick and cast as an integral part of the flag.

Unless otherwise agreed with the purchaser the colour shall be even and of the same shade throughout.

FINISH

5. The purchaser may agree upon a special surface finish or may accept the finish offered by the manufacturer.

PROTECTION FROM FROST

6. No material which has been exposed to temperatures below freezing point shall be used until such material has been completely thawed, nor shall products be moulded when the temperature of the mould itself is below freezing point. Flags shall be protected from damage by frost immediately after moulding for a period of at least 48 hours.

MOULDING

7. The products may be made by any process. The escape of the finer particles of mortar during the process of manufacture shall be prevented as far as practicable.

* B.S. 410 'Test sieves'.

A product described as 'Pressed' shall only be made by employing a pressure of not less than 1000 lbf per sq. in. over the entire surface receiving the pressure.

DIMENSIONS

8. The flags shall be manufactured in the following sizes:—

- 3 ft by 2 ft by 2 in.
- 3 ft by 2 ft by 2½ in.
- 2 ft 6 in. by 2 ft by 2 in.
- 2 ft 6 in. by 2 ft by 2½ in.
- 2 ft by 2 ft by 2 in.
- 2 ft by 2 ft by 2½ in.
- 1 ft 6 in. by 2 ft by 2 in.
- 1 ft 6 in. by 2 ft by 2½ in.

On all of the foregoing dimensions a tolerance of $\pm \frac{1}{16}$ in. shall be permitted.

FREEDOM FROM DEFECTS

9. The thickness of each flag shall be uniform, all angles shall be true right angles, the edges shall be clean and sharp, and the wearing surface shall be true and free from any winding.

On being fractured, the interior of the flags shall present a clean homogeneous appearance.

COST OF TESTS AND MANUFACTURER'S CERTIFICATE

10. The manufacturer shall satisfy himself that the products comply with the requirements of this British Standard and, if requested, shall forward a certificate to this effect to the purchaser or his representative.

The manufacturer shall, if requested to do so, supply a certificate stating the date of manufacture of the products.

If the purchaser or his representative requires independent tests, the samples shall be taken before or immediately after delivery at the option of the purchaser or his representative. The tests shall be carried out in accordance with this standard on the written instructions of the purchaser or his representative.

The vendor shall be entitled to charge at the contract rates for all products which are found to comply with the requirements of this standard, but shall make no charge for the samples selected in accordance with Clauses 12 and 13.

Unless otherwise specified at the time of the enquiry and order, the cost of the tests shall be borne as follows:—

- a.* By the manufacturer, in the event of results showing that the products do not comply with the standard.
- b.* By the purchaser, in the event of the results showing that the products comply with the standard.

FACILITIES FOR SAMPLING, TESTING, ETC.

11. The purchaser or his representative shall, at all reasonable times, have access to the place where the flags are manufactured or stored, for the purpose of examining and sampling the materials and flags, and testing and marking the flags. The vendor shall, free of extra charge, provide or make arrangements for the provision of every facility and all labour required for such examination, sampling, testing, and marking before delivery, and shall provide and maintain, or make arrangement for providing and maintaining in good working order, suitable, convenient, and accurate apparatus for testing sample flags as hereinafter provided.

NUMBER OF SAMPLE FLAGS FOR TESTING

12. For the purpose of the three tests specified in Clause 13 the purchaser or his representative shall select three sample flags for every order of 1000 yards super or less and one further sample flag for every further 1000 yards super or part of 1000 yards super comprising the same order.

TESTS

13. A sample or samples of the aggregate shall be taken in accordance with Part 1 of B.S. 812* and shall be tested for quality and grading, in accordance with the provisions of Clause 3 of this British Standard.

The sample flags selected in accordance with the provisions of Clause 12 shall comply with the following tests for transverse strength, rate of wear, and absorption of water.

a. Test for transverse strength. When tested in the manner described in Appendix A, flags 2 in. thick shall support for at least one minute a total load of not less than 1250 lb. for each foot of width, and flags 2½ in. thick shall support for at least one minute a total load of not less than 1900 lb. for each foot of width.

b. Test for rate of wear. When tested in the manner described in Appendix B, the wear on the face of each sample shall be uniform in character and the average loss in weight shall not be more than 2 lb.

c. Test for absorption of water. When tested in the manner described in Appendix C, the average increase in weight by absorption of water in the first ten minutes shall not exceed 2.5 per cent of the dry weight of the test pieces, and the total absorption shall not exceed 6.5 per cent of the dry weight after 24 hours' immersion.

RETESTS

14. Should any test sample fail to comply with the requirements of any of the tests specified in Clause 13, tests shall be repeated on the same number of samples from flags comprising the same order.

* B.S. 812 Methods for the 'sampling and testing of mineral aggregates, sands and fillers'.

Should these further test samples fail to comply with the requirements of the tests, the whole of the flags comprising the order shall be deemed not to comply with the tests. Should the samples pass the tests then the whole of the flags comprising the order shall be deemed to comply with the tests.

APPENDIX A

TEST FOR TRANSVERSE STRENGTH

Each sample flag selected in accordance with the provision of Clause 12 shall be supported upon two steel bearers (A), each $\frac{1}{4}$ in. wide on the supporting surfaces (see Fig. 1), parallel to each other and 1 ft 6 in. apart. The flag (B) shall be placed upon the bearers with its wearing face uppermost and its shorter sides parallel to the bearers. The bearers shall be level in all directions, and shall be so arranged as to support the flag when under test throughout its whole width. The load (W) shall be applied through the medium of a hardwood fillet to a space 2 in. wide in the centre of the unsupported portion of the flag, and extending the whole width of the flag, parallel to the bearers. It shall be steadily and uniformly applied, starting from zero at a rate not exceeding 112 lb. per ft of width (measured parallel to the bearers) per ten seconds, up to the maximum load specified in Clause 13a which shall be maintained for at least one minute.

APPENDIX B

TEST FOR RATE OF WEAR

Samples shall be 2 ft by 1 ft and may be from the flags used for the transverse test, but for each test shall comprise at least three separate flags. They shall be tested by means of the apparatus shown in Fig. 2, which comprises a rectangular container (A) having solid ends (B) secured through their centres at a distance apart of 22 in. to a steel shaft $1\frac{1}{2}$ in. in diameter (C) and with one or more of its sides having openings therein 22 in. by 10 in. The shaft projects from the ends of the container and is supported on bearings arranged so as to maintain the shaft horizontal and allow it to revolve freely at all times.

The samples (D) shall, after being dried to a constant weight* at a temperature not exceeding 37.7°C (100°F), and weighed, be secured in position, covering openings in the sides of the container, with their wearing faces inwards.

After placing in the container 1000 hard steel or chilled cast iron balls, and closing all openings, it shall be revolved for 24 hours at a regular speed of 60 revolutions per minute in one direction, and for 24 hours at the same speed in the reverse direction. The dust shall be removed from the machine at the end of the first period of 24 hours before the test in the reverse direction is commenced. The balls shall have a diameter not greater than $\frac{1}{2}$ in. and not less than $\frac{7}{16}$ in.

A suitable counter shall be fitted to the apparatus for accurately recording the number of revolutions of the container.

* A sample shall be considered as having been dried to constant weight when it does not lose more than 0.2 per cent of its original weight (i.e. its weight at the commencement of the test) in 24 hours under the conditions specified.

APPENDIX C

TEST FOR ABSORPTION OF WATER

A test piece of the full thickness of the flag, and approximately 4 inches square, having two cut and two moulded edges, shall be taken from each sample flag. The test pieces shall be dried for 72 hours in a suitably ventilated drying oven, the temperature of which, as measured by a thermometer suspended centrally, is between 100°C and 105°C (212°F and 221°F). Immediately on removal from the oven they shall be placed in a desiccator, cooled to room temperature and weighed. They shall then be submerged in water, the temperature of which is between 15°C and 18°C (59°F and 64.4°F) for a period of ten minutes, at the end of which time they shall be taken out, immediately wiped with a dry cloth for a period of $\frac{1}{2}$ minute, and again weighed. They shall then be submerged in water again for a total period of 24 hours, at the end of which time they shall be taken out, wiped with a dry cloth and weighed.

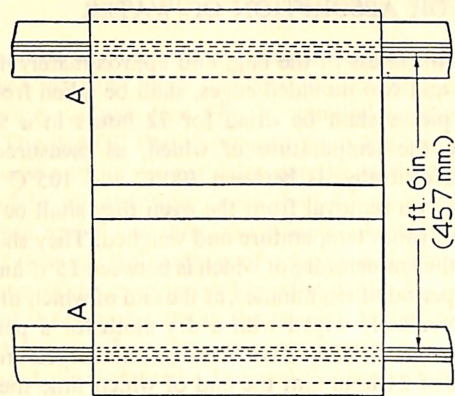
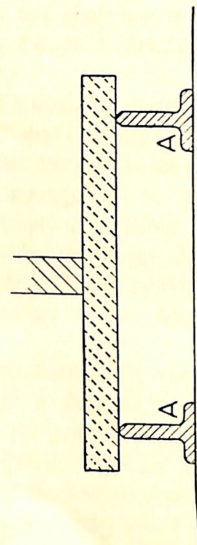


Fig. 1. Method of transverse test

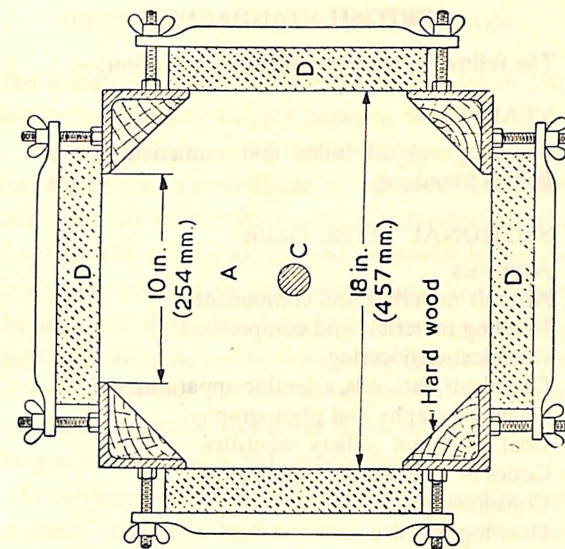
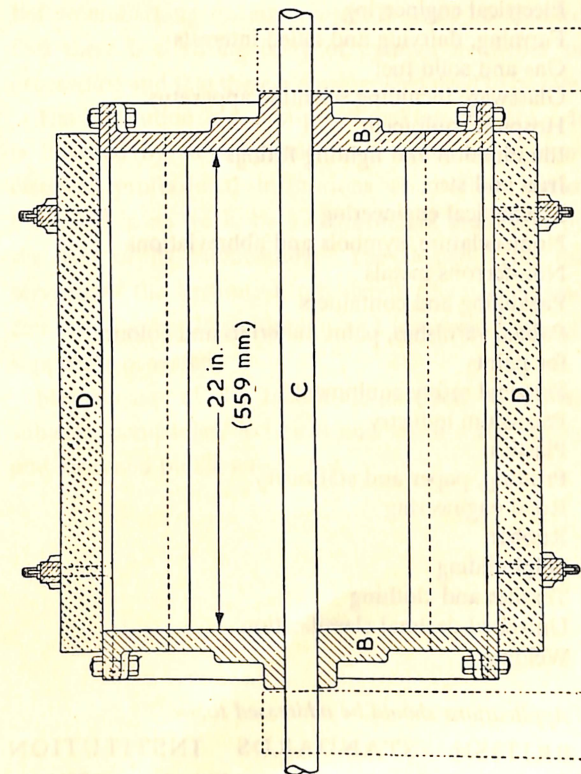


Fig. 2. Apparatus for testing rate of wear

BRITISH STANDARDS

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BRITISH STANDARDS INSTITUTION

The British Standards Institution was founded in 1901 and incorporated by Royal Charter in 1929.

The principal objects of the Institution as set out in the charter are to co-ordinate the efforts of producers and users for the improvement, standardization and simplification of engineering and industrial materials; to simplify production and distribution; to eliminate the waste of time and material involved in the production of an unnecessary variety of patterns and sizes of articles for one and the same purpose; to set up standards of quality and dimensions, and to promote the general adoption of British Standards.

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