

**SANS 1058: 2007**

**SOUTH AFRICAN NATIONAL STANDARD**

**Concrete paving blocks**

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## Concrete paving blocks

### 1 Scope

This standard covers blocks made from concrete, which are used for the construction of paved surfaces.

### 2 Normative references

The following referenced documents are indispensable for the application of this document. All normative documents are subject to revision and, since any reference to a normative document is deemed to be reference to the latest edition of that document, parties to agreement based on this document are encouraged to take steps to ensure the use of the most recent editions of the normative documents indicated below. Information on currently valid national and international standards can be obtained from Standards South Africa.

BS	1014,	Pigments for Portland cement and Portland cement products.
BS	1610,	Methods for the load verification of testing machines.
SANS	1083	Aggregates from natural sources. – Aggregates for concrete.
SANS	1491-1	Portland cement extenders – Part 1: Ground granulated blast furnace slag.
SANS	1491-2	Portland cement extenders – Part 2: Fly ash.
SANS	1491-3	Portland cement extenders – Part 3: Silica fume.
SANS	5863,	Concrete tests – Compressive strength of hardened concrete.
SANS	50197-1	Cement – Part 1: Composition, specifications and conformity criteria for common cements

### 3. Definitions

For the purposes of this specification the following definitions shall apply:

#### 3.1

**acceptable**

acceptable to the authority administering this standard, or to the parties concluding the purchase contract, as relevant

#### 3.2

**block**

block with all overall plan dimensions being less than 295mm, manufactured in concrete, used in the construction of paved surfaces

#### 3.3

**defective**

product that fails in one or more respects to comply with the requirements of the standard.

**4. Requirements**

**4.1 Materials**

**4.1.1 Cement**

The cement shall comply with the requirements of SANS 50197-1. If extenders are used they shall comply with the requirements of SANS 1491-1, 1491-2 and 1491-3

**4.1.2 Aggregates**

Aggregates shall comply with the requirements of SANS 1083

**4.1.3 Water**

The water used in the mixing of the concrete shall be free from impurities that might impair the strength or durability of the concrete

**4.1.4 Pigments**

Pigments used for colouring the concrete shall comply with the requirements of BS1014

**4.2 Shape, appearance and colour**

**4.2.1 Shape**

All blocks shall be true to the appropriate designated pattern

**4.2.2 Appearance**

All blocks shall be sound and free of cracks or other defects that would interfere with the proper placing of the blocks or significantly impair the strength or permanence of the construction and the appearance.

**4.2.3 Colour**

When blocks are required to have coloured surfaces the colour shall be as required and extended from the exposed surface at least 6mm into the block

**4.2.4 Surface Texture**

The surface texture of the blocks shall be as required.

NOTE Should the purchaser so require, the manufacturer shall supply to the purchaser for his retention three blocks of the agreed colour and surface texture to serve as a reference sample of the possible range of such colour and surface texture at the time of order.

**4.3 Dimensions**

**4.3.1 Linear**

The work size of a block, as indicated by the overall length, overall width and overall height shall be as required and, when determined in accordance with 6.3, shall not differ from the required nominal values by more than the applicable tolerance given in Table 1.

Critical dimensions and their tolerances shall be as required.

**Table 1 - Tolerances**

1	2
Dimension	Tolerances mm
Length	± 2
Width	± 2
Height	± 3

**4.3.2 Squareness**

The height of the block as measured at any point along the perimeter of the block shall not vary by more than 2%.

**4.4 Tensile splitting strength**

The average and individual tensile splitting strengths of blocks determined in accordance with 6.4 shall be at least the values given in columns 2 and 3 respectively of Table 2 appropriate to the class of block given in column 1.

**Table 2 – Tensile Splitting Strength of blocks**

1	2	3
Class of block	Tensile splitting strength MPa	
	Average	Individual
1	2,2	1,8
2	2,8	2,5

**4.5 Abrasion resistance**

The average and individual mass loss of blocks determined in accordance with 6.5 shall not exceed 12g and 15g respectively.

**4.6 Water absorption**

The average and individual water absorption of blocks determined in accordance with 6.6 shall not exceed 6,5% and 8,0% respectively.

**5. Marking**

Each consignment of units shall be accompanied by a delivery note in which the following information is given:

- a) the manufacturer's name
- b) trade name, or trade mark of the product
- c) the date of manufacture or related code number;
- d) in the case of units having a coloured finish, the colour;
- e) quality mark

**6. Inspection and testing**

**6.1 Inspection and test frequency**

Test specimens are to be selected at random and at periodic intervals throughout the production shift as given in table 3.

**Table 3 Inspection and test frequency**

1	2	3	4
Aspect	Production	Clause	Frequency
Shape Appearance Colour/Texture	All	4.2	12 blocks per machine per shift
Dimensions	Per machine	4.3	12 blocks per machine per shift
Tensile Splitting	Per machine	4.4	12 blocks per machine per shift
*Abrasion resistance	Per machine	4.5	8 blocks per machine per shift
Water absorption	Per machine	4.6	6 blocks per machine per shift

**Note:** The same test specimens can be used for more than 1 of the above tests  
 \* This test is not required for blocks with an exposed aggregate surface.

**6.2 Shape, appearance, colour & texture**

Inspect the units and check for compliance with the requirements of 4.2

**6.3 Dimensions**

**6.3.1 Apparatus**

Measuring equipment capable of measuring with an accuracy of 0,5mm

**6.3.2 Procedure**

**6.3.2.1** Remove any loose particles from the faces of the blocks

**6.3.2.2** Take all linear measurements to the nearest 0,5mm. The critical dimensions of units of irregular shapes and squareness shall be measured in a way that results in repeatable and reproducible values.

**6.3.2.3** Check for compliance with the requirements of 4.3

**6.4 Tensile splitting strength test**

**6.4.1 Apparatus**

The testing machine shall have a scale with an accuracy of  $\pm 3\%$  over the range of the anticipated test loads and be capable of increasing the load at specified rates.

The testing machine shall be equipped with a device composed of two rigid bearers (see Figure 1) whose contact surface has a radius of  $75 \pm 5$  mm

The two bearers shall be held in the same vertical plane with a tolerance of  $\pm 1$  mm at the bearers end. The upper bearer shall be able to rotate in its transverse axis.

The two packing pieces of plywood shall be  $10 \pm 1$  mm wide (b),  $4 \pm 1$  mm thick (a) and at least 10 mm longer than the anticipated fracture plane.

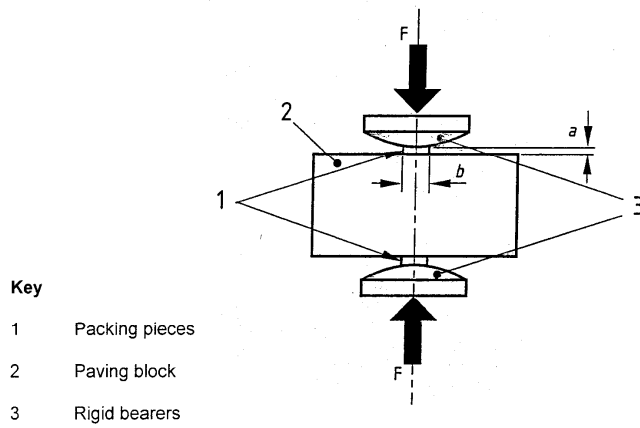


Figure 1 – Principle of testing

**6.4.2 Preparation of test blocks**

Use whole blocks and remove any burrs, high spots, etc. If a face is rough, textured or curved it shall be prepared by grinding or capping. The least amount of materials shall be removed to produce a flat face.

Other methods of preparation can be used for routine testing providing there is a correlation between the results of the two methods, e.g. using ungrounded rough textured or curved blocks instead of ground blocks.

Immerse the blocks in water at  $20 \pm 5$  °C for  $24 \pm 3$  h, remove, wipe dry and test immediately.

**6.4.3 Procedure**

**6.4.3.1** Place the block in the testing machine with the packing pieces on the upper face and the bed face in contact with the bearers. Ensure that the packing pieces and the axes of the bearers are in line with the splitting section of the block.

**6.4.3.2** The splitting section(s) shall be chosen according to the following order of priority.

- a) The test is carried out along the longest splitting section of the block, parallel and symmetrical to the edges, thus permitting that the following condition is satisfied.
  - The distance of the splitting section to any side face is at least 0,5 times the block thickness over at least 75% of the splitting section area.
- b) If the above mentioned condition cannot be met, the test is carried out along two splitting sections chosen in a way that the following condition is satisfied:
  - The distance of one splitting section to the other splitting section or to any side face of the block is at least 0,5 times the block thickness over at least 75% of the splitting section length considered.
- c) If neither of the above mentioned conditions can be met, the splitting section shall be chosen in such a way that the greatest total proportional section length satisfying the distance requirement is obtained.
- d) If the block section is square, hexagonal or circular in plan, the splitting section shall be chosen so that it is the shortest length passing through the centre of the plan area.

**6.4.3.3** Apply the load smoothly and progressively at a rate which corresponds to an increase in stress of  $0,05 \pm 0,01$  MPa/s. Record the failure load.

**6.4.3.4.** Calculate the area of the failure plane(s) of the block tested from the equation:



$$S = l \times t$$

where

$S$  is the area of the failure, in square millimetres:

$l$  is the mean of two measurements of the failure length, one at the top and one at the bottom of the block, in millimetres;

$t$  is the thickness of the block at the failure plane in millimetres and is the mean of three measurements; one in the middle and one at either end.

**6.4.4 Calculation of test results**

If testing is performed along two transverse test sections of the same block, the splitting strength of the block is considered the mean of the two individual results.

6.4.4.1 Calculate the strength  $T$  in megapascal of the block tested from the equation:

$$T = 0,637 \times k \times \frac{P}{S}$$

where

$T$  is the strength, in megapascals:

$P$  is the failure load, in newtons:

$k$  is a correction factor for the block thickness calculated by the equation:

$$k = 1,3 - 30 (0,18 - t/1\ 000)^2 \text{ if } 140 \text{ mm} < t \leq 180 \text{ mm}$$

or

$$k = 1,3 \quad \text{if } t > 180 \text{ mm}$$

or

for  $t \leq 140$  mm determined from Table F.1.

**Table 4 – Thickness correction factor,  $k$ .**

$t$ (mm)	40	50	60	70	80	90	100	110	120	130	140
$k$	0,71	0,79	0,87	0,94	1,00	1,06	1,11	1,15	1,19	1,23	1,25

6.4.4.2 Calculate the strength of each block and the average of the 12 blocks and check for compliance with 4.4

**6.5 Abrasion resistance test**

**6.5.1 Apparatus**

The following is required:

- (a) A well-ventilated drying oven with a cubic capacity not less than 3 times the total volume of specimens being dried and capable of maintaining a temperature of  $110 \pm 8^\circ\text{C}$ .
- (b) A balance of adequate capacity and accurate to within 0.1.g
- (c) A tumbler machine as described in Figures 2 and 3

The fixtures shall consist of the following:

- (i) A container comprised of a rectangular steel container of dimensions specified in Figures 2 & 3.

The ends shall be secured through their centres to a steel shaft that projects from the ends and is supported so that it can rotate freely about its longitudinal axis.

The four sides of the container shall have centrally placed openings. (See Figure 2)

Angle plates shall be fitted to each corner of the interior of the container, forming a  $45 \pm 1^\circ$  angle at the intersection of plate and container. The angle plates shall finish flush with the external surface of the container.

NOTE: Steel of Brinell hardness grade 360-400 is required for the angle plates.

The container's axle shall be kept in an exact horizontal position ( $0$  to  $0.5^\circ$  to the horizontal) throughout the test.

- (ii) Cover plates of 8 mm thick hardened steel plate, to cover the four sides of the container, each having four tapering holes (see Figure 2) and provided with at least three locating pins to ensure their accurate placement over the openings of the box.

NOTE: Steel of Brinell hardness grade 360-400 is required for the cover plates.

The holes are offset from the axial centre in the direction of the rotation of the container.

When the cover plates are clamped to the sides, it shall be ensured that –

- (A) an imaginary line tangential to the four openings at the reverse side of the plate would be parallel with the axis of the drive shaft; and
- (B) sufficient space exists between the container and the cover plates to allow dust to escape. When measured at 8 equi-spaced points around the perimeter of each cover plate, the average gap shall be  $\geq 2$  mm.

NOTES:

- 1 Distortions caused by use and those existing from manufacture would normally satisfy the requirements of items (A) and (B) above.
- 2 When the cover plates fit so tightly as to not satisfy this requirement, a placement of 2mm thick washers around the locating pins will provide an adequate gap.
- 3 Current machines, which have angle plates and cover plates and which are not of the correct steel hardness, may be used until new plates are required.

(iii) Clamping plates that shall be so designed as to ensure that the test specimens are firmly secured to the cover plate for the duration of the test without causing damage.

NOTE: This requires the use of two timber packing blocks per specimen between the cover plate and the specimens. (See Figure 3)

(iv) A revolution counter that shall be fitted to the tumbler.

(v) A suitable driving mechanism capable of rotating the tumbler at a rate of  $60 \pm 1$  rpm.

The tumbler drive shall only be able to rotate the tumbler in the direction of the offset of the holes in the cover plates.

(vi) Six hundred steel ball bearings, each of  $15.9 \pm 0.1$  mm diameter and weighing  $16.2 \pm 0.2$  g. Replace ball bearings when either their mass or their dimensions fall outside the specified limits.

NOTE: The tumbler machine has 16 holes so either specimens from 2 machines or from 2 production shifts can be tested simultaneously.

(d) A vacuum cleaner with hand brush attachment

(e) A timing device capable of being read to the nearest second.

**6.5.2 Preparation of test blocks**

These test blocks may be full units or cut from larger blocks and shall have a test face of sufficient size to fully cover the holes in the cover plates.

Blocks larger than these dimensions may be cut wet with a diamond saw prior to testing. Such cutting blocks shall leave the test area of the wearing face to be tested undamaged.

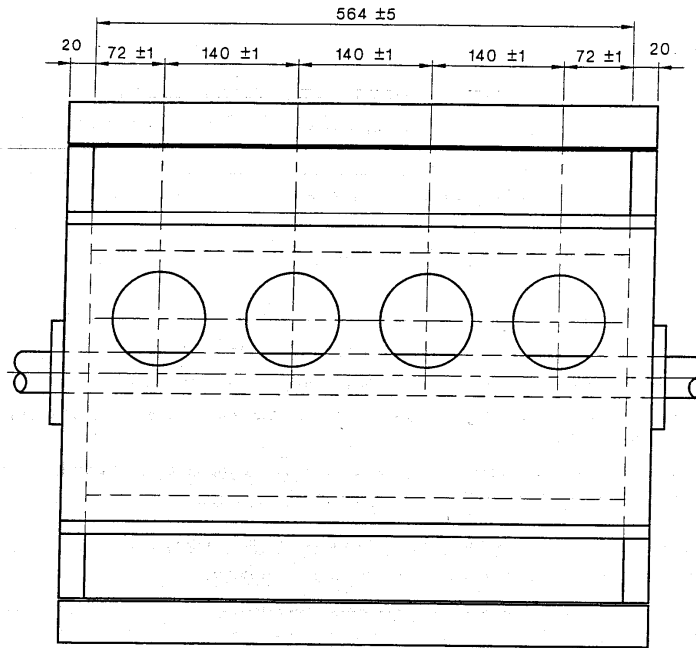
**6.5.3 Procedure**

**6.5.3.1** Thoroughly remove all loose particles from all blocks so that any subsequent loss in material is only due to abrasion. Either washing or dry brushing can be used.

**6.5.3.2** Condition blocks by drying in a ventilated oven at  $100 \pm 5^\circ\text{C}$  for  $24 \pm 3$ h.

**6.5.3.3** Allow all blocks to cool in the laboratory for a minimum of 5 h before testing.

**6.5.3.4** Within 30 minutes prior to testing, determine the mass of each test specimen,  $m_1$ , to the nearest 0.1g.

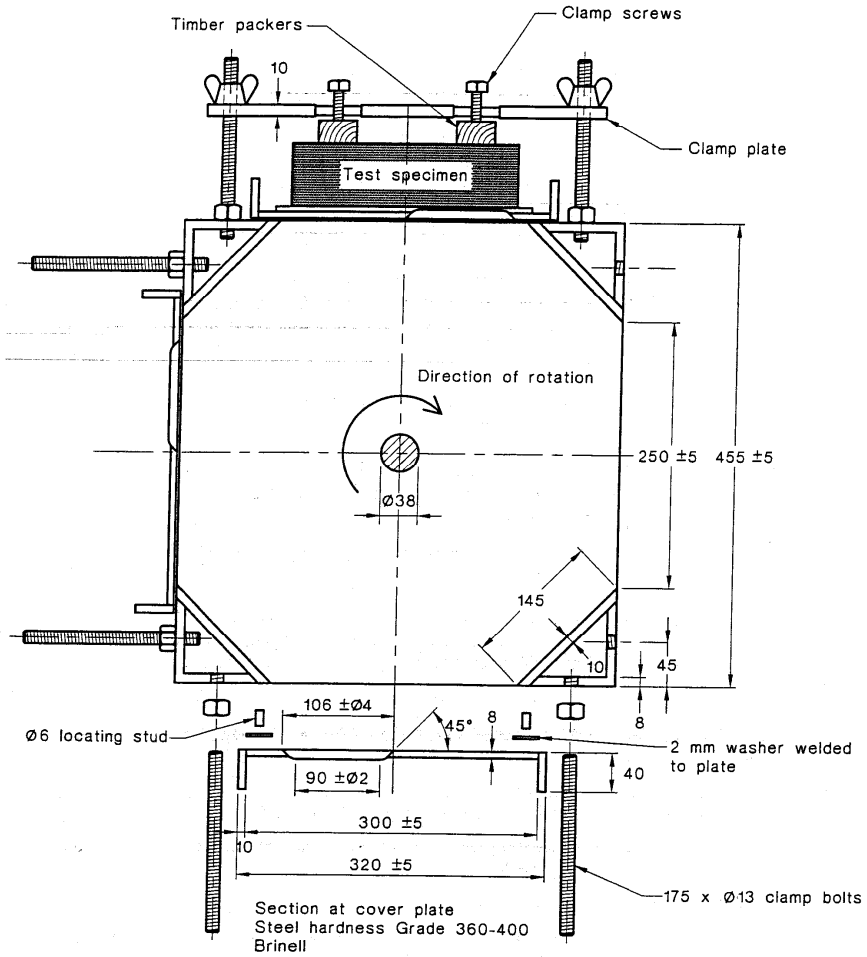


**PLAN**

NOTE: Dimensions without tolerances are nominal.

DIMENSIONS IN MILLIMETRES

FIGURE 2. PLAN OF TUMBLER WITH COVER PLATES



DIMENSIONS IN MILLIMETRES

FIGURE 3- SECTION THROUGH TUMBLER

6.5.3.5 Secure the test blocks to the abrasion testing machine with their wearing face inwards and centrally (on width) placed over the apertures in the cover plate.

Four double-sided pavers that have two differently textured wearing faces, test the two surfaces independently.

Add the steel balls to the container before securing the last block,

6.5.3.6 After all holes are covered by test specimens, run the machine for 3600 +30, -0 revolutions at the rate of  $60 \pm 1$  revolutions per minute.

6.5.3.7 At the end of the tumbling, carefully detach the blocks.

6.5.3.8 Thoroughly remove all dust and loose particles from the test blocks by brushing and vacuuming.

6.5.3.9 Within 30 minutes of cleaning, weigh each test block, and record its mass,  $m_2$ , to the nearest 0.1g.

**6.5.4.1 Calculation**

Calculate the mass loss of each block,  $m_1 - m_2$ , and the average mass loss of the 8 blocks and check for compliance with 4.5

**6.6 Water absorption test**

**6.6.1 Apparatus**

The apparatus needed for testing water absorption comprises

a) a well-ventilated oven to accommodate six specimens and capable of maintaining a temperature of 100°C to 105 °C,

b) a balance or mass meter with a capacity of 30 kg and accuracy of 1 g.

**6.6.2 Procedure**

6.6.2.1 Dry the blocks in the oven for  $24 \pm 3$ h at a temperature of  $100 \pm 5$ °C,

6.6.2.2 Allow all blocks to cool in the laboratory for a minimum of 5h before testing.

6.6.2.3 Determine and record the mass of each block,  $m_1$

6.6.2.4 Submerge the blocks in water at a temperature 20 °C to 25°C for  $24 \pm 3$  h

6.6.2.5 Remove the blocks from the water and remove the excess surface water with a damp cloth.

6.6.2.6 Immediately determine and record the mass of each block,  $m_2$

**6.6.3 Calculation**

6.6.3.1 Water absorption is given by

$$\text{Water absorption} = \frac{m_2 - m_1}{m_1} \times 100$$

**6.6.3.2** Calculate the percentage water absorption of each block and the average of the 6 blocks and check for compliance with 4.6

**APPENDIX A  
(Normative)**

**Notes to purchasers**

- A.1** The following requirements must be specified in tender invitations and in each order or contract:
- a) the class (see 4.4)
  - b) the nominal (stated) dimensions (see 4.3)
- A.2** The following requirements must be agreed upon between the manufacturer and the purchaser:
- a) the surface texture and colour (see 4.2)
- A.3** The following should be agreed upon between the manufacturer and the purchaser:
- when relevant, the sampling plan (see B.2)

**APPENDIX B  
(Informative)**

**Quality verification of concrete paving blocks produced to the requirements laid down in the specification**

- B.1** When a purchaser requires ongoing verification of the quality of concrete paving blocks, it is suggested that, instead of concentrating solely on evaluation of the final product, he also direct his attention to the manufacturer's quality system. In this connection it should be noted SANS ISO 9001 covers the provisions of an integrated quality system.
- B.2** If the blocks do not bear the standardization mark and no information about the implementation of quality control or testing during manufacture is available to help in assessing the quality of a lot, and a purchaser wishes to establish by inspection and testing of samples of the final product whether a lot of the blocks produced to this specification complies with its requirements, a sampling plan based on applicable statistical tables should be agreed upon between the manufacturer and purchaser.
- It must be noted that
- a) such a sampling plan applies to fully manufactured products only; and
  - b) a lot that in terms of the plan is deemed to comply with the specification, could contain defective blocks to an extent proportional to that permitted by the relevant acceptance numbers given in the sampling table.