No. PCH-HC(10) FFC-Misc- 60819-978
Government of Himachal Pradesh
Department of RD & PR.

From
The Secretary (RD&PR) to the
Government of HP.

To
(1) All the Deputy Commissioners
in Himachal Pradesh.

(2) All the Chief Executive Officers
Zila Parishad in HP.

(3) All the Executive Engineer, RD & PR
in Himachal Pradesh.

(4) All the Deputy Director-cum-PO DRDA
in Himachal Pradesh.

(5) All the District Panchayat Officers
in Himachal Pradesh.

(6) All the Block Development Officers
in Himachal Pradesh.

Shimla-171009 dated 13 November, 2018

Subject:- Standardization of paver blocks and tiles for execution of various civil works by PRIs.

The matter regarding standardization of construction material particularly paver blocks and tiles for the use of Panchayati Raj Institutions in execution of various civil works was under the active consideration of the department for a long time and a committee was constituted to standardized above items. Therefore, the following construction material alongwith its specification as stipulated in relevant IS Code is hereby approved on the recommendation of the said committee:-

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Description</th>
<th>Reference of IS Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Precast concrete blocks for paving (paver block)</td>
<td>IS 15658: 2006</td>
</tr>
<tr>
<td>2</td>
<td>Cement concrete flooring tiles (Plain cement, plain coloured and terrazo type)</td>
<td>IS 1237: 2012</td>
</tr>
<tr>
<td>3</td>
<td>Chequered cement concrete and chequered terrazo tiles</td>
<td>IS 13801: 1993</td>
</tr>
</tbody>
</table>
It has been also approved that these items shall be procured from the authorized supplier of controller of stores Himachal Pradesh or through GEM portal. In case, rate contracts of these items are not available and are also not available on the GEM portal then these items shall be procured from open market as per specification stipulated in relevant IS Code by inviting tenders through advertisement in at least three newspapers having wide circulation in the area or e-Tendering as the case may be. Details of the specification have been uploaded in the website of Department of Rural Development as well as Panchayati Raj for ready reference. **It will be mandatory for the concerned technical authority to give justification of the rates in the estimate.** Before placing the supply order or awarding the work to lowest bidder justification of rates may be prepared and got approved from the one step up authority who has accorded Technical sanction.

You are, requested to follow the above guidelines in its letter and spirit and adhere to the specification given above while procuring paver blocks and tiles for various civil works. Any violation will be viewed seriously and personal liability of the concerned technical officer/ official shall be fixed.

Yours Faithfully

[Signature]

Special Secretary (RD&PR) to the Government of Himachal Pradesh.
Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

Indian Standard

PRECAST CONCRETE BLOCKS FOR PAVING — SPECIFICATION

ICS 93.080.20

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

June 2006

Price Group 8
FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Flooring, Wall Finishing and Roofing Sectional Committee had been approved by the Civil Engineering Division Council.

Concrete paver blocks were first introduced in Holland in the fifties as replacement of paver bricks which had become scarce due to the post-war building construction boom. These blocks were rectangular in shape and had more or less the same size as the bricks. During the past five decades, the block shape has steadily evolved from non-interlocking to partially interlocking to fully interlocking to multiply interlocking shapes. Consequently, the pavements in which non-interlocking blocks are used are designated as ‘Concrete Block Pavement (CBP)’ or non-interlocking CBP, and those in which partially, fully or multiply interlocking blocks are used are designated as ‘Interlocking Concrete Block Pavement (ICBP)’.

CBP/ICBP consists of a surface layer of small-element, solid un-reinforced pre-cast concrete paver blocks laid on a thin, compacted bedding material which is constructed over a properly profiled base course and is bounded by edge restraints/kerb stones. The block joints are filled using suitable fine material. A properly designed and constructed CBP/ICBP gives excellent performance when applied at locations where conventional systems have lower service life due to a number of geological, traffic, environmental and operational constraints. Many number of such applications for light, medium, heavy and very heavy traffic conditions are currently in practice around the world.

Different countries have adopted different norms for quality assurance of concrete blocks and construction and maintenance of CBP/ICBP, based on research and development and empirical advances in this field and suitable to the geological, traffic and environmental conditions prevailing in those countries. In India, research and development work in this field started at Central Road Research Institute in the nineties. Currently the Indian Institute of Technology (IIT), Kharagpur, has joined in the research and development efforts. Application of CBP/ICBP technique is finding increasing popularity around the country, especially in metropolitan cities as well as in large and medium towns. Currently a number of entrepreneurs are engaged in this business. Considering the increasing scope for application of this specialized paving technique, BIS recognizes the need to regulate the quality of paver blocks and CBP/ICBP so that the purchaser is ensured of uniformly good quality of blocks and CBP/ICBP. Accordingly, this standard specification for concrete paver blocks is being formulated.

In the formulation of this standard, assistance has been derived from the following publications:

a) EN 1338 : 2003 (E), Concrete Paving Blocks — Requirements and Test Methods, European Committee for Standardization, Rue de Stassart, 36, B1050, Brussels
b) CAN3-A231.2-M85 Pre-cast Concrete Pavers, Canadian Standards Association
c) AS/NZS 4456.5 : 1997 — Masonary Units and Segmental Pavers — Methods of Test — Method 5 : Determining breaking load of segmental paving units
d) IRC : SP-63-2004 — Guidelines for the Use of Interlocking Concrete Block Pavement

The composition of the Committee responsible for formulation of this standard is given at Annex J.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (revised)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.
AMENDMENT NO. 2 NOVEMBER 2011 TO IS 15658 : 2006 PRECAST CONCRETE BLOCKS FOR PAVING — SPECIFICATION

[Page 5, Table 2, col 2 (see also Amendment No. 1)] — Substitute ‘Plan area, Max, $A_{sp}$’ for ‘Plan area, Min, $A_{sp}$’ at Sl No. vii).

(CED 5)

*Reprography Unit, BIS, New Delhi, India*
Indian Standard
PRECAST CONCRETE BLOCKS FOR PAVING — SPECIFICATION

1 SCOPE

1.1 This standard specifies constituent materials, products requirements and test methods for solid, un-reinforced pre-cast cement concrete paver blocks and complimentary products used for light, medium, heavy and very heavy traffic paving applications and other applications.

1.2 The standard does not cover concrete masonry units, cellular (hollow) concrete blocks, fly ash masonry blocks, permeable concrete blocks, grid blocks, grass stones and cement concrete flooring tiles.

2 REFERENCES

The standards listed in Annex A contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

3.1 Actual Dimension — Measured dimensions of a paver block.

3.2 Arris — Part of a block where two faces meet which can be bevelled, rounded, chamfered, or splayed, as shown in Fig. 1.

3.3 Aspect Ratio — The ratio of length to thickness of a paver block.

3.4 Backing Layer — Layer of concrete on the lower face of a two-layer paver block, made of material same as or different from that used in the wearing layer of the block.

3.5 Bed Face — That surface of a paver block which, when paved, comes in direct contact with the bedding material.

3.6 Chamfer — Bevelled arris, as shown in Fig. 1.

3.7 Chased Side Face — The side face of a paver block, having a recessed profile, as shown in Fig. 1.

3.8 Colour — Appearance of a paver block due to pigment used in concrete, other than natural cement colour.

![Fig. 1 Examples of Arris (Bevelled, Rounded, Chamfered) Chased Side Face and Draw](image-url)
3.9 Complementary Product — A pre-cast usually of the shape of part of a block, used for fitting into gaps remaining in a block-paved area, for complete coverage of paved surface.

3.10 Draw — Intended angle of the side face from the vertical plane over the full height of a paver block, as shown in Fig. 1.

3.11 Efflorescence — White deposit formed on paver blocks due to diffusion of calcium hydroxide (solution of lime) present in cement, together with various dissolved salts, onto the external surface.

3.12 False Joints/Grooves — Regularly shaped depressions on the wearing layer of a paver block.

3.13 Format — Work dimensions of a paver block, specified in the order of overall length, overall width and thickness.

3.14 Interlocking Mechanism — The mechanism which allows adjacent paver blocks to key into one another and facilitates the sharing of shear, bending and thrust forces between adjacent blocks in a paved system.

3.15 Interlocking/Dentated/Inter-connected Paver Blocks — Paver blocks which key into one another on some or all vertical faces, when paved in any pattern.

3.16 Length — Shortest distance between farthest opposite vertical faces of a parallelepiped enclosing a paver block, excluding the dimensions due to any spacer nibs.

3.17 Overall Length — The longer side of a rectangle with the smallest area enclosing a paver block, excluding the area due to any spacer nibs.

3.18 Overall Width — Shorter side of a rectangle with the smallest area enclosing a paver block, excluding any spacer nibs.

3.19 Plan Area — Horizontal area bounded by the vertical faces of a paver block, excluding the area due to any spacer nibs.

3.20 Paver Block — Solid, un-reinforced pre-cast cement concrete paving units used in the surface course of pavements, with minimum horizontal cross-section of 50 mm from any edge in any direction, having aspect ratio not more than four, except for complementary products.

3.21 Pigment — Synthetic or natural colouring agents used in the concrete mix to produce coloured paver blocks.

3.22 Secondary Processing — Manufacturing process to texture the upper face of a paver block, executed before or after hardening of manufactured block.

3.23 Side Face — That face of a paver block which is generally in the vertical direction when paved and which faces adjacent block.

3.24 Skid Resistance — Resistance to relative movement between a vehicle tyre and the trafficked surface of a pavement.

3.25 Slip Resistance — Ability to resist relative movement between a pedestrian foot and the trafficked surface of a pavement.

3.26 Spacer Nibs — Small protruding profiles on the vertical face of a paver block used as a device for keeping minimum joint gap while paving blocks.

3.27 Squareness — Normally between the vertical faces of a paver block and the horizontal wearing surface, and parallelism between wearing surface and lower horizontal surface.

3.28 Surface Relief — Regularly shaped protrusions on the wearing surface of a paver block.

3.29 Surface Texture — Microscopic and macroscopic features of the wearing face of a paver block.

3.30 Thickness — Vertical distance between the upper face and bed face of a paver block.

3.31 Wearing Layer — Layer of concrete or mortar on the upper face of a two-layer paver block, made of material same as or different from that used in the backing layer of the block.

3.32 Wearing Face — That surface of a paver block which, when paved, faces the atmosphere and which is directly subjected to loading and movement of vehicle tyres or pedestrian traffic.

3.33 Wearing Face Area — Horizontal area bounded by the vertical faces of a paver block, minus the area reduced due to the presence of arris.

3.34 Width — Shortest distance between nearest opposite vertical faces or corners of a paver block.

3.35 Wipe — Fine cement mortar slurry applied to the upper face of a paver block or supplementary product.

3.36 Work Dimension — Any dimension of a paver block specified for its manufacture, to which the actual dimension should conform, within specified permissible tolerances.

4 MATERIALS

4.1 Cement and Cement Admixtures

4.1.1 Cement used shall be any of the following:

a) 33 Grade ordinary Portland cement conforming
b) 43 Grade ordinary Portland cement conforming to IS 8112,
c) 53 Grade ordinary Portland cement conforming to IS 12269,
d) Portland slag cement conforming to IS 455,
e) Portland-pozzolana cement (fly ash based) conforming to IS 1489 (Part 1),
f) Portland-pozzolana cement (calcined clay based) conforming to IS 1489 (Part 2), and
g) Rapid hardening Portland cement conforming to IS 8041.

4.1.2 Mineral admixtures, namely, fly ash conforming to Grade 1 of IS 3812 (Part 1), silica fume conforming to IS 15388, ground granulated blast furnace slag conforming to IS 12089 and rice husk ash and metakaoline conforming to the requirements specified in IS 456 may be used as part replacement of ordinary portland cement provided uniform blending with cement is obtained.

4.2 Aggregates

4.2.1 Coarse Aggregates

4.2.1.1 Coarse aggregates shall comply with the requirements of IS 383. As far as possible crushed/semi-crushed aggregates shall be used. For ensuring adequate durability, the aggregate used for production of blocks shall be sound and free of soft or honeycombed particles.

4.2.1.2 Other types of aggregates such as slag and crushed, over-burnt brick or tile which may be found suitable with regard to strength, durability of concrete and freedom from harmful effects may be used in preparation of concrete for production of paver blocks. However such aggregates shall not contain more than 0.5 percent of sulphates as SO₃ and shall not absorb more than 2 percent of their own mass of water.

4.2.1.3 Heavy weight aggregates or light weight aggregates such as bloated clay aggregates and sintered fly ash aggregates may also be used provided the purchaser is satisfied with the data on the properties of concrete made with them.

4.2.1.4 The nominal maximum size of coarse aggregates used in production of paver blocks shall be 12 mm.

4.2.2 Fine Aggregates

Fine aggregates shall conform to the requirements of IS 383. Both river/quarry sand and stone dust meeting the requirements can be used.

4.3 Admixtures

Admixtures, when used shall conform to IS 9103. Previous experience with and data on such materials should be considered in relation to the specified standards of mechanization, supervision and workmanship in production of blocks. They may be added for specific requirements without affecting other quality parameters.

4.4 Pigments

4.4.1 Synthetic or natural pigments may be used in concrete mix to obtain paver blocks with desired shades of colours. The pigment used should result in durable colours of paver blocks. It shall not contain matters detrimental to concrete. Pigments, either singly or in combination, conforming to the following Indian Standards may preferably be used:

<table>
<thead>
<tr>
<th>Pigments</th>
<th>Relevant Indian Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black or Red or Brown pigment</td>
<td>IS 44</td>
</tr>
<tr>
<td>Green pigment</td>
<td>IS 54</td>
</tr>
<tr>
<td>Blue pigment</td>
<td>IS 55</td>
</tr>
<tr>
<td>White pigment</td>
<td>IS 56</td>
</tr>
<tr>
<td>Yellow pigment</td>
<td>IS 411</td>
</tr>
</tbody>
</table>

Pigment quantity to be restricted to a maximum of 9 percent by weight of cement content. The pigment should be finer than the cement (Fineness value between 2-15 m²/kg).

4.4.2 The pigments shall not contain zinc compounds or organic dyes.

4.4.3 Lead pigments shall not be used unless otherwise specified by the purchaser.

4.5 Water

The water used in production of paving blocks shall conform to the requirements specified in IS 456.

5 GRADE DESIGNATION OF PAVER BLOCKS AND DESIGN OF CONCRETE BLOCK PAVEMENT

Recommended grades of paver blocks to be used for construction of pavements having different traffic categories are given in Table 1. Since zero slump concrete is used in production of paver blocks, the quality of blocks produced will depend upon various parameters like the capacity of compaction and vibration of machine, grade of cement used, water content, quality of aggregates used, their gradation and mix design adopted, additives used, handling equipment employed, curing methods adopted, level of supervision, workmanship and quality control achieved, etc.
### Table 1 Recommended Grades of Paver Blocks for Different Traffic Categories

**(Clauses 5 and 9.1.4)**

<table>
<thead>
<tr>
<th>S1 No.</th>
<th>Grade Designation of Paver Blocks</th>
<th>Specified Compressive Strength of Paver Blocks at 28 Days N/mm²</th>
<th>Traffic Category</th>
<th>Recommended Minimum Paver Block Thickness mm</th>
<th>Traffic Examples of Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>i)</td>
<td>M-30</td>
<td>30</td>
<td>Non-traffic</td>
<td>50</td>
<td>Building premises, monument premises, landscapes, public gardens/parks, domestic drives, paths and patios, embankment slopes, sand stabilization area, etc</td>
</tr>
<tr>
<td>ii)</td>
<td>M-35</td>
<td>35</td>
<td>Light-traffic</td>
<td>60</td>
<td>Pedestrian plazas, shopping complexes ramps, car parks, office driveways, housing colonies, office complexes, rural roads with low volume traffic, farm houses, beach sites, tourist resorts local authority footways, residential roads, etc</td>
</tr>
<tr>
<td>iii)</td>
<td>M-40</td>
<td>40</td>
<td>Medium-traffic</td>
<td>80</td>
<td>City streets, small and medium market roads, low volume roads, utility cuts on arterial roads, etc</td>
</tr>
<tr>
<td>iv)</td>
<td>M-50</td>
<td>50</td>
<td>Heavy-traffic</td>
<td>100</td>
<td>Bus terminals, industrial complexes, mandi houses, roads on expansive soils, factory floor, service stations, industrial pavements, etc</td>
</tr>
<tr>
<td>v)</td>
<td>M-55</td>
<td>55</td>
<td>Very heavy-traffic</td>
<td>120</td>
<td>Container terminals, ports, docks yards, mine access roads, bulk cargo handling areas, airport pavements, etc</td>
</tr>
</tbody>
</table>

**NOTES**

1. Non-traffic areas are defined as areas where no vehicular traffic occurs.
2. Light-traffic is defined as a daily traffic up to 150 commercial vehicles exceeding 30 kN laden weight, or an equivalent up to 0.5 million standard axles (MSA) for a design life of 20 years (A standard axle is defined as a single axle load of 81.6 kN).
3. Medium traffic is defined as a daily traffic of 150 – 450 commercial vehicles exceeding 30 kN laden weight, or an equivalent of 0.5 to 2.0 MSA for a design life of 20 years.
4. Heavy traffic is defined as a daily traffic of 450 – 1500 commercial vehicles exceeding 30 kN laden weight, or an equivalent of 2.0 to 5.0 MSA for a design life of 20 years.
5. Very heavy-traffic is defined as a daily traffic of more than 1500 commercial vehicles exceeding 30 kN laden weight, or an equivalent of more than 5.0 MSA for a design life of 20 years.

### 6 PHYSICAL REQUIREMENTS

#### 6.1 General

6.1.1 The physical requirements of paver blocks are categorized into two groups, namely:

   a) Obligatory requirements shall be for ensuring durability of pavements constructed with paver blocks as well as obtaining better levels of service in block paving work, and

   b) Optional requirements shall be as per the specific demands of the purchaser. These are described in 6.2 and 6.3.

6.1.2 All paver blocks shall be sound and free of cracks or other visual defects which will interfere with the proper paving of the unit or impair the strength or performance of the pavement constructed with the paver blocks.

6.1.3 When two layer paver blocks are manufactured there shall be proper bonding between the layers. Delamination between the layers shall not be permitted. The compressive strength of the two layer blocks shall meet the specified requirements.

6.1.4 When paver blocks with false joints, surface reliefs or projections are supplied, the same shall be specified. Also, the surface features shall be well formed and be devoid of any defects.

#### 6.2 Obligatory Requirements

6.2.1 **Visual Inspection**

Visual inspection of quality of paver blocks shall be
carried out in natural daylight, prior to the tests for other properties. The inspection shall be conducted by the purchaser and the manufacturer jointly at a location agreed to between them, normally at the site or factory. Visual inspection shall be conducted as per 7.1.

NOTE — When efflorescence occurs and it is not deleterious to the performance of the blocks in use and is not considered significant.

6.2.2 Dimensions and Tolerances

6.2.2.1 The recommended dimensions and tolerances for paver blocks, measured as per the method in Annex B, are given in Table 2. Minimum block thickness shall be 50 mm and maximum 120 mm. The thicknesses 60 mm, 80 mm, 100 mm and 120 mm will be considered as standard thicknesses under this specification.

6.2.2.2 All blocks manufactured to meet this specification shall have arris/chamfer as per the dimensions and tolerances given in Table 2.

6.2.3 Thickness of Wearing Layer

When paver blocks are manufactured in two layers, the wearing layer shall have minimum thickness as specified in Table 2. The thickness of the wearing layer shall be measured at several points along the periphery of the paver blocks. The arithmetic mean of the lowest two values shall be the minimum thickness of the wearing layer.

<table>
<thead>
<tr>
<th>S1 No.</th>
<th>Dimension</th>
<th>Measurement Method, Ref to</th>
<th>Recommended Values</th>
<th>Tolerance Limit for Paver Block</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Thickness &lt; 100 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i)</td>
<td>Width, W</td>
<td>Annex B</td>
<td>To be specified by manufacturer</td>
<td>± 2 mm</td>
</tr>
<tr>
<td>ii)</td>
<td>Length, L</td>
<td>Annex B</td>
<td>To be specified by manufacturer</td>
<td>± 2 mm</td>
</tr>
<tr>
<td>iii)</td>
<td>Thickness, T</td>
<td>Annex B</td>
<td>50 to 120 mm</td>
<td>± 3 mm</td>
</tr>
<tr>
<td>iv)</td>
<td>Aspect ratio (L/T)</td>
<td>Annex B</td>
<td>Maximum : 4.0</td>
<td>+ 0.2</td>
</tr>
<tr>
<td>v)</td>
<td>Arris/chamfer</td>
<td>Annex B</td>
<td>Minimum: 5 mm</td>
<td>± 1 mm</td>
</tr>
<tr>
<td>v)</td>
<td>Thickness of wearing layer</td>
<td>6.2.3</td>
<td>Minimum : 7 mm</td>
<td>+ 2 mm</td>
</tr>
<tr>
<td>vii)</td>
<td>Plan area, A_sp</td>
<td>Annex B</td>
<td>Maximum : 0.03 m²</td>
<td>+ 0.001 m²</td>
</tr>
<tr>
<td>viii)</td>
<td>Wearing face area, A_sw</td>
<td>Annex B</td>
<td>Minimum 75 percent of Plan Area</td>
<td>- 1 percent</td>
</tr>
<tr>
<td>ix)</td>
<td>Squareness</td>
<td>Annex B</td>
<td>Nil</td>
<td>± 2 mm</td>
</tr>
</tbody>
</table>

6.2.4 Water Absorption

The water absorption, being the average of three units, when determined in the manner described in Annex C, shall not be more than 6 percent by mass and in individual samples, the water absorption should be restricted to 7 percent.

6.2.5 Compressive Strength

6.2.5.1 Compressive strength of paver blocks shall be determined as per the method given in Annex D. Paver block strength shall be specified in terms of 28 days compressive strength. In case the compressive strength of paver blocks is determined for ages other than 28 days, the actual age at testing shall be reported. The average 28 days compressive strength of paver blocks shall meet the specified requirement. Individual paver block strength shall not be less than 85 percent of the specified strength. In case blocks of age less than 28 days are permitted to be supplied, correlation between 28 days strength and the strength at specified age for identified batch/mix of blocks shall be established.

6.2.5.2 The specified average 28 days compressive strengths of different grades of paver blocks are given in Table 3 and the minimum specified strengths of individual paver blocks are given in 6.2.5.1.
Table 3 Compressive Strength Requirements of Concrete Paver Blocks
(Clauses 6.2.5.2 and 9.1.4)

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Grade of Paver Blocks</th>
<th>Minimum Average 28 Days Compressive Strength N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>i) M-30</td>
<td>(2)</td>
</tr>
<tr>
<td></td>
<td>ii) M-35</td>
<td>(3)</td>
</tr>
<tr>
<td></td>
<td>iii) M-40</td>
<td>≥ fₜₐ + 0.825 x established standard deviation (rounded off to nearest 0.5 N/mm²)</td>
</tr>
<tr>
<td></td>
<td>iv) M-50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>v) M-55</td>
<td></td>
</tr>
</tbody>
</table>

6.2.6 Abrasion Resistance

The abrasion resistance of paver blocks should be determined as per the method given in Annex E. It may be specified the limits to the test results, which should be complied with by the manufacturer.

6.3 Optional Requirements

6.3.1 Tensile Splitting Strength

The tensile splitting strength of paver blocks should be determined as per the method given in Annex F. When required by the purchaser, the test values for tensile splitting strength of paver blocks may be specified by the manufacturer.

6.3.2 Flexural Strength/Breaking Load

The flexural strength/breaking load of paver blocks should be determined as per the method given in Annex G. When required by the purchaser, the test values for flexural strength breaking load of paver blocks may be specified by the manufacturer.

6.3.3 Freeze-Thaw Durability

The freeze-thaw durability test of paver blocks should be conducted as per the method given in Annex H. When required for application in freeze-thaw environment, the purchaser may specify limits to the test results, which should be complied with by the manufacturer.

6.3.4 Colour and Texture

When required, the colour and texture of paver blocks should be mutually agreed to between the purchaser and the manufacturer.

7 TEST METHODS

7.1 Visual inspection shall be conducted by first examining each paver block from a sample lot for any elimination. The blocks shall then be laid out on a level floor in any desired paving pattern, approximately covering a square area of 1 m². Any visual defects of paver blocks, including cracks and flaking, shall be recorded by observing the paved blocks from a distance of approximately 2 m from each edge of the paved area. The texture and colour of the paver blocks shall be compared with the manufacturer’s free samples supplies earlier to the purchaser.

7.2 Tests other than for visual aspects shall be carried out in a laboratory agreed to between the purchaser and the manufacturer. Wherever applicable, calibrated equipment shall be used for tests.

7.3 Compliance with the obligatory physical requirements laid down in 6.2 shall be ensured by conducting tests as described in Annexes B to E. Compliance with optional physical requirements laid down in 6.3 shall be ensured by conducting tests as described in Annexes F to H.

7.4 Unless otherwise specified in the enquiry or order, the cost of the tests shall be borne as follows:

a) By the manufacturer, in the event of the test results showing that the paver blocks do not conform to this specification, or

b) By the purchaser, in the event of the test results showing that the paver blocks conform to this specification.

8 SAMPLING

8.1 When the product has been submitted to an assessment of conformity by a third party, acceptance testing is not required, except in case of dispute between the purchaser and the manufacturer, when acceptance testing may be carried out. In such cases, depending upon the circumstances of the case in dispute, the required number of blocks shall be sampled from each batch of the consignment of blocks up to a quantity of 50 000 blocks.

8.2 When the product has not been submitted to an assessment of conformity by a third party, the required number of blocks shall be sampled from each batch of the consignment of blocks up to a quantity of 25 000 blocks.

8.3 When the quantity of a partial batch is less than half of the quantities mentioned in 8.1 and 8.2, that partial batch of the consignment shall be added to the previous full batch.

8.4 The paver blocks selected for testing shall be representative of the consignment, the points of selection being evenly distributed through the consignment.

8.5 The number of blocks to be sampled from each batch for each test shall be as given in Table 4.
Table 4 Sampling Requirements
(Clause 8.5)

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Property</th>
<th>Requirement Ref to Cl No.</th>
<th>Test Method Ref to</th>
<th>Number of Paver Blocks for Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i)</td>
<td>Visual Inspection</td>
<td>6.2.1</td>
<td>7.1</td>
<td>Quality Assurance by Third Party</td>
</tr>
<tr>
<td>ii)</td>
<td>Dimensions</td>
<td>6.2.2</td>
<td>Annex B</td>
<td>8</td>
</tr>
<tr>
<td>iii)</td>
<td>Thickness of wearing layer 3</td>
<td>6.2.3</td>
<td>6.2.3</td>
<td>8</td>
</tr>
<tr>
<td>iv)</td>
<td>Water absorption</td>
<td>6.2.4</td>
<td>Annex C</td>
<td>3</td>
</tr>
<tr>
<td>v)</td>
<td>Compressive strength</td>
<td>6.2.5</td>
<td>Annex D</td>
<td>8</td>
</tr>
<tr>
<td>vi)</td>
<td>Tensile splitting strength</td>
<td>6.3.1</td>
<td>Annex E</td>
<td>8</td>
</tr>
<tr>
<td>vii)</td>
<td>Flexural strength/breaking load</td>
<td>6.3.2</td>
<td>Annex F</td>
<td>8</td>
</tr>
<tr>
<td>viii)</td>
<td>Abrasion resistance</td>
<td>6.2.6</td>
<td>Annex G</td>
<td>8</td>
</tr>
<tr>
<td>ix)</td>
<td>Freeze-thaw durability</td>
<td>6.3.3</td>
<td>Annex H</td>
<td>3</td>
</tr>
</tbody>
</table>

1) The number within brackets is the number to be sampled to avoid secondary sampling from the batch if on the basis of the conformity criteria, additional blocks are required to be tested to assess conformity.
2) These blocks may be used for subsequent tests.
3) Only apply for blocks with a separate every layer.

8.6 The sample paver blocks shall be marked for future identification of the consignment it represents. The block shall be kept under cover and protected from extreme conditions of temperature, relative humidity and wind till they are required for test. The test shall be undertaken as soon as practicable after the sample has been taken.

9 ACCEPTANCE CRITERIA

9.1 Obligatory Requirements

9.1.1 The lot shall be considered as conforming to the requirements of this specification if the conditions mentioned in 9.1.2 to 9.1.4 are satisfied.

9.1.2 The sampled blocks tested for dimensions, aspect ratio, chamfer, plan area, wearing face area, deviation from squareness, and, in the case of two layer blocks, thickness of wearing layer shall meet the tolerance limit specified in Table 2. Blocks with visual defects with sample lot shall not be more than three.

9.1.3 For water absorption, the mean value of 3 samples determined shall be not more than the maximum limit specified in 6.2.4.

9.1.4 The 28 days compressive strengths and tolerance of 8 numbers of paver blocks manufactured as per the grades of paver blocks recommended in Table 1 shall be as given in Table 3.

9.2 Optional Requirements

Acceptance criteria for optional requirements shall be as per mutual agreement by the purchaser and manufacturer.

10 MARKING

10.1 Concrete paver block/package shall be marked with the following information suitably:

a) Identification of the manufacturer,
b) Grade of paver blocks, and
c) Date of manufacture.
10.2 BIS Certification Marking

The paver blocks may also be marked with the Standard Mark.

10.2.1 The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which a licence for use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

ANNEX A

(Clause 2)

LIST OF REFERRED INDIAN STANDARDS

<table>
<thead>
<tr>
<th>IS No.</th>
<th>Title</th>
<th>IS No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>50:1980</td>
<td>Specification for lead and scarlet chromes (third revision)</td>
<td>1489</td>
<td>Specification for Portland Pozzolana cement:</td>
</tr>
<tr>
<td>56:1993</td>
<td>Specification for Prussian blue (iron blue) for paints (second revision)</td>
<td>2185</td>
<td>Specification for concrete masonry units: Part 1 Hollow and solid concrete blocks (second revision)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12089:1987</td>
<td>Specification for granulated slag for manufacture of Portland slag cement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15388:2003</td>
<td>Specification for silica fume</td>
</tr>
</tbody>
</table>
ANNEX B

(Clauses 6.2.2.1, 7.3 and D-4.1 and Tables 2 and 4)

METHOD FOR DETERMINATION OF DIMENSIONS, ASPECT RATIO, PLAN AREA, WEARING FACE AREA AND DEVIATION FROM SQUARENESS

B-1 LENGTH, WIDTH, THICKNESS AND ASPECT RATIO

B-1.1 Apparatus
The apparatus shall comprise:
   a) Steel callipers, and
   b) Steel rule capable of measuring up to 300 mm to an accuracy of 0.5 mm.

B-1.2 Specimens
The paver block specimens, selected from the group of blocks of specified shape, size and thickness as per the sampling procedure in 8 and as per the number of specimens mentioned in Table 4 shall be tested.

B-1.3 Procedure
B-1.3.1 Length and Width
The length and width of the specimen (see Fig. 2) shall be measured across two opposite faces by using the steel callipers or steel rule. Two representative positions shall be used for measurement of length and three for measurement of width. The mean values of length and width for the block shall be noted to the nearest 1 mm.

B-1.3.2 Thickness
The thickness of the specimen (see Fig. 2) shall be measured at four different positions. The mean value of the thickness of the block shall be noted to the nearest 1 mm.

B-1.3.3 Aspect Ratio
The aspect ratio of the specimen shall be calculated by dividing the mean length by the mean depth as determined by the procedures in B-1.3.1 and B-1.3.2 and shall be noted to the nearest 0.1.

B-2 ARRIS

B-2.1 Apparatus
The apparatus shall comprise of steel callipers.

B-2.2 Specimens
The paver block specimens selected as per the sampling procedure in 8 and as per the number of specimens mentioned in Table 4 shall be tested.

B-2.3 Procedure
The depth and width of arris of the specimen (see Fig. 2) shall be measured across two opposite faces, to the nearest 0.1 mm, by using the steel callipers. Four representative positions shall be used for measurement of depth and width. The mean values of depth and width of arris for the block shall be noted to the nearest 0.1 mm.

B-3 PLAN AREA AND WEARING FACE AREA

B-3.1 Apparatus
The apparatus shall comprise:
   a) Balance capable of weighing 1 N to an accuracy of 0.0001 N;

---

FIG. 2 LENGTH (L), WIDTH (W) AND THICKNESS (Th) OF PAVER BLOCKS
b) Sheets of thin cardboard of uniform thickness;

c) Sharp pencil;

d) Odd-leg marking gauge (see Fig. 3);

e) Sharp scissors; and

f) Steel rule marked with graduations of 0.5 mm.

B-3.2 Specimens

The paver block specimens selected as per the sampling procedure in 8 and as per the number of specimens mentioned in Table 4 shall be tested.

B-3.3 Procedure

B-3.3.1 Plan Area \( A_{wp} \) (Method 1)

The test specimen shall then be weighed, while suspended by a metal wire, and completely submerged in water, and the weight shall be recorded in N to the nearest 0.01 N \( (W_a) \). They shall be removed from the water and allowed to drain for one minute by placing them on a 10 mm or coarser wire mesh. Visible water on the specimen shall be removed with a damp cloth. The specimen shall then be immediately weighed and the weight for each specimen noted in N to the nearest 0.01N \( (W'_w) \). The volume of the specimen shall be calculated as follows:

\[
\text{Volume} = \left( W'_w - W_a \right) \times 10^{-3} \text{m}^3
\]

The thickness of the specimen in mm shall be determined as per B-1.3.2. The volume shall be divided by thickness to obtain plan area in \( \text{mm}^2 \).

In the case of rectangular specimens, the plan area may also be calculated by multiplying the length by the width, as determined by the procedure in B-1.3.1.

B-3.3.2 Plan Area \( A_w \) (Method 2)

The specimen shall be placed, wearing face facing up, on the cardboard and its perimeter traced with the pencil. The shape shall be cut out accurately with the scissors and weighed to the nearest 0.000 1 N, and the result recorded as mass \( m_{wp} \). A rectangle measuring 200 mm x 100 mm, accurately cut out from the same cardboard, shall also be weighed to the nearest 0.000 1 N, and the result recorded as mass \( m_{bl} \). The plan area for the block shall be calculated from the

Fig. 2 Length \( (L) \), Width \( (W) \) and Thickness \( (T_h) \) of Paver Blocks
formula:

\[ A_{sp} = \frac{20000 \ m_{sp}}{m_{std}} \text{ mm}^2 \]

**B-3.3.3 Wearing Face Area (A_{sw})**

The width of the arris of the block shall be measured at four different locations and their mean value determined. A ballpoint pen refill shall be fixed to the odd-leg marking gauge and the gauge shall be set to the measured mean value of width of the arris. The gauge so set shall be used to draw a line, indicating the width of the arris, along the periphery of the cardboard shape of the plan area of the block with mass \( m_{wp} \), as obtained in B-3.3.2. The marked arris width on the cardboard shall be neatly cut away with the scissors, and the cardboard shall be weighed to the nearest 0.0001 N and the result recorded as mass \( m \). The wearing face area for the block shall be calculated from the formula:

\[ A_{sw} = \frac{20000 \ m_{sp}}{m_{std}} \text{ mm}^2 \]

**B-4 DEVIATION FROM SQUARENESS**

**B-4.1 Apparatus**

The apparatus shall comprise:

- Engineer's square or a profiled template, and

**B-4.2 Specimens**

The paver block specimens selected as per the sampling procedure in 8 and as per the number of specimens mentioned in Table 4 shall be tested.

**B-4.3 Procedure**

With the stock of the square or profiled template in contact with the top or bottom surface of the block, the blade shall be brought into contact with the vertical face of the block. The clearance, if any, between the square or profiled template and the vertical face of the block shall be measured to the nearest 0.1 mm with the feeler gauge at points 10 mm inside each top and bottom edge of the block. This measurement shall be repeated at six sensibly different locations around the block, and the average of the feeler gauge measurement noted as the deviation from squareness for the block, which shall be noted to the nearest 0.1 mm.

**B-5 REPORT**

The individual and average values of measured dimensions, arris, aspect ratio, plan area, wearing face area and deviation from squareness of specimens tested as per B-1, B-2, B-3 and B-4 shall be reported.

**ANNEX C**

*(Clauses 6.2.4 and 7.3 and Table 4)*

**METHOD FOR DETERMINATION OF WATER ABSORPTION**

**C-1 APPARATUS**

The balance used shall be sensitive to within 0.5 percent of the mass of the smallest specimen tested.

**C-2 SPECIMENS**

The paver block specimens selected as per the sampling procedure in 8 and as per the number of specimens mentioned in Table 4 shall be tested.

**C-3 PROCEDURE**

**C-3.1 Saturation**

The test specimen shall be completely immersed in water at room temperature for 24 ± 2 h. The specimen then shall be removed from the water and allowed to drain for 1 min by placing them on a 10 mm or coarser wire mesh. Visible water on the specimens shall be removed with a damp cloth. The specimen shall be immediately weighed and the weight for each specimen noted in N to the nearest 0.01 N (\( W_{w} \)).

**C-3.2 Drying**

Subsequent to saturation, the specimens shall be dried in a ventilated oven at 107 ± 7°C for not less than 24 h and until two successive weighings at intervals of 2 h show an increment of loss not greater than 0.2 percent of the previously determined mass of the specimen. The dry weight of each specimen (\( W_{d} \)) shall be recorded in N to the nearest 0.01 N.

**C-4 CALCULATION**

**C-4.1 Percent Water Absorption (W Percent)**

The percent water absorption shall be calculated as follows:

\[ W \text{ percent} = \left( \frac{W_{w} - W_{d}}{W_{d}} \right) \times 100 \]

**C-5 REPORT**

The individual and average values of measured water absorption of specimens tested as per C-1 to C-4 shall be reported.
ANNEX D
(Clauses 6.2.5.1 and 7.3 and Table 4)

METHOD FOR DETERMINATION OF COMPRESSIVE STRENGTH

D-1 APPARATUS

D-1.1 Testing Machine

The apparatus shall comprise of compression testing machine which shall be equipped with two steel bearing blocks for holding the specimen. It is desirable that the blocks have a minimum hardness of 60 (HRC) and a minimum thickness of 25 mm. The block on top through which load is transmitted to the specimen shall be spherically seated. The block below on which the specimen is placed shall be rigidly fitted. When the bearing area of the steel blocks is not sufficient to cover the bearing area of the paver block specimen, two steel bearing plates meeting the requirements of D-1.2 shall be placed between the steel plates fitted on the machine and the specimen.

D-1.2 Steel Bearing Blocks and Plates

The surfaces of the steel bearing blocks and plates shall not depart from the plane by more than 0.025 mm in any 15 mm dimension. The centre of the sphere of the spherically seated upper bearing block shall coincide with the centre of the bearing surface. If bearing plate is used, the centre of the sphere of the upper bearing block shall be on a line passing vertically through the centroid of the specimen bearing face. The spherically seated block shall be held closely in its seat, but shall be free to turn in any direction. The diameter of the face of the bearing blocks shall be at least 150 mm. When steel plates are employed between the steel bearing blocks and the specimen, the plates shall have a thickness equal to at least one-third the distance from the edge of the bearing block to the most distant corner of the specimen. In no case shall the plate thickness be less than 12 mm.

D-2 SPECIMENS

The paver block specimens selected as per the sampling procedure in 8 and as per the number of specimens mentioned in Table 4 shall be tested.

D-3 CAPPING OF SPECIMENS

D-3.1 The upper face of the specimens shall be capped by one of the methods described in C-3.1 and C-3.2 of Annex C of IS 2185 (Part 1).

D-3.2 Alternatively, 4 mm thick plywood sheets of size larger than the specimens by a margin of at least 5 mm from all edges of the specimen shall be used for capping the specimens.

D-3.3 When specimen with surface projections or surface relief features has to be tested, its upper face shall be made plain by suitable capping, such as by using sulphur or gypsum, before testing.

D-4 PROCEDURE

D-4.1 The dimensions and plan areas of the specimens shall be determined as described in Annex B. The blocks shall be stored for 24 ± 4 h in water maintained at a temperature of 20 ± 5°C. The bearing plates of the testing machine shall be wiped clean. The specimens are aligned with those of the bearing plates.

D-4.2 The load shall be applied without shock and increased continuously at a rate of 15 ± 3 N/mm²/min until no greater load can be sustained by the specimen or delamination occurs. The maximum load applied to the specimen shall be noted in N.

D-5 CALCULATION

The apparent compressive strength of individual specimen shall be calculated by dividing the maximum load (in N) by the plan area (in mm²). The corrected compressive strength shall be calculated by multiplying the apparent compressive strength by the appropriate correction factor from Table 5. The strength shall be expressed to the nearest 0.1 N/mm².

Table 5 Correction Factors for Thickness and Arris/Chamfer of Paver Block for Calculation of Compressive Strength

<table>
<thead>
<tr>
<th>S1 No.</th>
<th>Paver Block Thickness mm</th>
<th>Correction Factor for</th>
<th>Plain Block</th>
<th>Arrised/Chamfered Block</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>i)</td>
<td>50</td>
<td>0.96</td>
<td>1.03</td>
<td></td>
</tr>
<tr>
<td>ii)</td>
<td>60</td>
<td>1.00</td>
<td>1.06</td>
<td></td>
</tr>
<tr>
<td>iii)</td>
<td>80</td>
<td>1.12</td>
<td>1.18</td>
<td></td>
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<tr>
<td>iv)</td>
<td>100</td>
<td>1.18</td>
<td>1.24</td>
<td></td>
</tr>
<tr>
<td>v)</td>
<td>120</td>
<td>1.28</td>
<td>1.34</td>
<td></td>
</tr>
</tbody>
</table>

For other thickness of paver blocks between 50 mm and 120 mm, linear extrapolation of concrete factor shall be made.

D-6 REPORT

The individual and average compressive strength of the specimens tested as per D-1 to D-5 shall be reported.
ANNEX E

(Clauses 6.2.6 and 7.3 and Table 4)

METHOD FOR DETERMINATION OF ABRASION RESISTANCE

E-1 APPARATUS
The abrasion testing machine shall be the same as described in Annex F of IS 1237 (see Fig. 4).

E-2 SPECIMENS

E-2.1 Square-shaped specimens measuring 71.0 ± 0.5 mm shall be cut from the block specimens selected as per the sampling procedure in 8 and as per the number of specimens mentioned in Table 4. The contact face and the opposite face of the specimen shall be parallel and flat. For determining the reduction in thickness as described in E-4, the opposite face shall, if appropriate, be ground parallel or otherwise machined so as to be parallel.

E-2.2 For testing dry specimens, the specimens shall be dried to constant mass at a temperature of 105 ± 5°C.

E-2.3 For testing wet/saturated specimens; the specimens shall be immersed in water for 7 days and wiped with a damp artificial sponge prior to each weighing (see E-3) so that all specimens appear equally damp.

E-3 PROCEDURE

E-3.1 The density of the specimen, \( PR \) shall be determined nearest to 0.1 g. The weight of the specimen shall be noted to nearest 0.1 g both prior to the abrasion test and after every four cycles (see E-4).

E-3.2 In the case of two-layer specimens, the density of specimens taken separately from the wearing layer shall be determined.

E-3.3 The grinding path of the disc of the abrasion testing machine shall be evenly strewn with 20 g of the standard abrasive powder as per F-3 of IS 1237. The specimen shall be fixed in the holding device such that the testing surface faces the grinding disc. The specimen shall be centrally loaded with 294 ± 3 N.

E-3.4 The grinding disc shall be run at a speed of 30 rpm. The disc shall be stopped after one cycle of 22 revolutions. The disc and contact face of the specimen shall be cleaned of abrasive powder and debris. The specimen shall be turned 90° in the clockwise direction and 20 g of abrasive powder shall be evenly strewn on the testing track before starting the next cycle.

E-3.5 When testing wet/saturated specimens, prior to each cycle, the track shall be wiped with a lightly damp artificial sponge and moistened before being strewn with the abrasive powder. From the start of the test, arrangement shall be made for drip-wetting of the central portion of the track, about 30 mm from the specimen (opposite to the direction of motion of
the disc), by supplying water drops at the rate of 180 to 200 drops (13 ml) per minute. During this test, it should be ensured that the abrasive powder continuously returns to the effective area of the track.

E-3.6 The test cycle shall be repeated 16 times, the specimen being turned 90° in the clockwise direction and spreading of 20 g of abrasive powder on the testing track after each cycle.

E-4 CALCULATION

The abrasive wear of the specimen after 16 cycles of testing shall be calculated as the mean loss in specimen volume, $\Delta V$, from the equation:

$$\Delta V = \frac{\Delta m}{PR}$$

Where:

$\Delta V$ = loss in volume after 16 cycle, in mm$^3$;

$\Delta m$ = loss in mass after 16 cycles, in g; and

$PR$ = density of the specimen, or in the case of two-layer specimens, the density of the wearing layer, in g/mm$^3$.

E-5 REPORT

The abrasive wear shall be reported to the nearest whole number of 1 000 mm$^3$ per 5 000 mm$^2$.

ANNEX F

(Clauses 6.3.1 and 7.3 and Table 4)

METHOD FOR DETERMINATION OF TENSILE SPLITTING STRENGTH

F-1 APPARATUS

F-1.1 The testing machine shall have a scale with an accuracy of ±3 percent over the range of the anticipated test loads and be capable of increasing the load at specified rates. The machine shall be equipped with a device composed of two rigid bearers (see Fig. 5) whose contact surface has a radius of 75 ± 5 mm. The two bearers shall be held in the same vertical plane with a tolerance of ± 1 mm at the bearers' end. The upper bearer shall be able to rotate in its transverse axis. The two packing pieces shall be 15 ± 1 mm wide (see 'b' in Fig. 5), 4 ± 1 mm thick (see 'a' in Fig. 5) and at least 10 mm longer than the anticipated fracture plane. The packing pieces shall be made of a material that meets the hardness criterion given in F-1.2.

F-1.2 When submitted to a punching test by means of a rod of circular cross-section, having a diameter of 16 ± 0.5 mm and applying a force at the rate of 48 ± 3 kN/min, the instantaneous penetration when the force of 20 ± 5 kN is achieved shall be equal to 1.2 ± 0.4 mm.

F-2 SPECIMENS

The paver block specimens selected as per the sampling procedure in 8 and as per the number of specimens mentioned in Table 4 shall be tested.

F-3 PREPARATION

Whole specimens shall be used and any burrs, high spots, etc, shall be removed. In case a face is rough, textured or curved, it shall be prepared by grinding or capping. The least amount of material shall be removed to obtain a flat face. The specimens shall be immersed in water at 20 ± 5°C for 24 ± 3 h, removed, wiped dry and immediately tested. Other methods of preparation may be used for routine testing, provided there is a correlation between the two methods, for example, using ungrounded rough textured or curved specimens instead of ground specimens.

F-4 PROCEDURE

F-4.1 The specimen shall be placed on the testing machine with the packing pieces on the upper face and the bed face, in contact with the bearers. It shall be ensured that the packing pieces and the axes of the bearers are in line with the splitting section of the specimen. The splitting section shall be chosen according to the following order of priority:

a) The test is carried out along the longest splitting section of the specimen, parallel and symmetrical to the edges, in such a way that the distance of the splitting section to any side face is at least 0.5 times the thickness of the specimen over at least 75 percent of splitting section area.

b) If the condition in (a) cannot be met, the test is carried out along two splitting sections, chosen in such a way that the distance from one splitting section to the other splitting section or to any side face of the specimen is at least 0.5 times the thickness of the specimen over at least 75 percent of the splitting section length considered.
c) If neither of the conditions in (a) or (b) 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) In case the section of the specimen is square, hexagonal or circular in plan, the splitting section shall be chosen in such a way that it is the shortest length passing through the centre of the plan area.

F-4.2 The load is smoothly and progressively applied at a rate which corresponds to an increase in stress of $0.05 \pm 0.01$ MPa. The failure load ($P$) is recorded in N, to the nearest 0.01 N.

F-5 CALCULATION

F-5.1 The area of the failure plane(s) of the specimen tested are calculated from the equation:

$$S = l \times t$$

where

$S =$ area of the failure, in mm$^2$;

$l =$ mean of two measurements of the failure length, one at the top and one at the bottom of the specimen, in mm; and

$t =$ mean of three measurements of thickness at the failure plane, one in the middle and one at either end, in mm.

F-5.2 The tensile splitting strength of the test specimen is calculated from the equation:

$$T = 0.637 \times k \times (P/S)$$

where

$T =$ tensile splitting strength, in MPa; and

$P =$ failure load N.

F-5.3 The failure load per unit length of the specimen is calculated for the equation:

$$F = (P/l)$$

where $F$ is the failure load, in N/mm.

F-5.4 If testing is conducted along two transverse sections of the same specimen, the splitting tensile strength of the specimen is the mean of the two individual results.

F-6 REPORT

The test report shall include the following information:

a) $T$, the tensile splitting strength of the specimen to the nearest 0.1 MPa; and

b) $F$, the failure load per unit length of the specimen to the nearest 10 N/mm.
ANNEX G
(Clauses 6.3.2 and 7.3 and Table 4)

METHOD FOR DETERMINATION OF FLEXURAL STRENGTH/BREAKING LOAD

G-1 APPARATUS
The apparatus for the test shall be the same as in 8 of IS 516, with the following modifications:

a) The supporting and loading rollers shall have diameter in the range of 25 to 40 mm. They shall extend on both sides beyond the dimensions of the specimens by at least 10 mm;

b) The distance from centre-to-centre of the two supporting rollers shall be adjustable to the overall length of the specimen minus 50 mm; and

c) The loading roller shall be arranged for application of load from the top of the specimen along the vertical centreline between the supporting rollers.

G-2 SPECIMENS
The paver block specimens selected as per the sampling procedure in 8 and as per the number of specimens in Table 4 shall be tested.

G-3 CAPPING OF SPECIMENS
G-3.1 The test specimens shall be capped by one of the methods described in D-3 of Annex D.

G-3.2 When specimen with surface projections or surface relief features has to be tested, its upper face shall be made plain by suitable capping, such as by using sulphur or gypsum before testing.

G-4 PROCEDURE
The test procedure shall be the same as in 8 of IS 516, with the following modifications:

a) The load shall be applied from the top of the specimen in the form of a simple beam loading through a roller placed midway between the supporting rollers, as shown in Fig. 6. Loading of irregular-shaped specimens shall be as shown in Fig. 7.

b) The load shall be applied without shock and increased continuously at a uniform rate of 6 kN/min.

c) The load shall be increased until the specimen fails, and the maximum load applied shall be recorded to the nearest N.

G-5 CALCULATION
The flexural strength of the specimen shall be calculated as follows:

\[ F_b = \frac{3Pl}{2bd^2} \]

where

- \( f_b \) = flexural strength, in N/mm²;
- \( P \) = maximum load, in N;
- \( l \) = distance between central lines of supporting rollers, in mm;
- \( b \) = average width of block, measured from both faces of the specimen, in mm; and
- \( d \) = average thickness, measured from both ends of the fracture line, in mm.

The maximum load \( P \) shall be reported as the breaking load, nearest to 1 N.

G-6 REPORT
The individual and average flexural strength and breaking load of the specimens tested as per G-1 to G-5 shall be reported.

G-7 SUGGESTED VALUES OF CHARACTERISTIC BREAKING LOAD
The suggested values of minimum breaking load for different applications are given below:

<table>
<thead>
<tr>
<th>Application</th>
<th>Minimum Breaking Load, kN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential pathways/public pedestrian paths</td>
<td>2</td>
</tr>
<tr>
<td>Residential driveways — Light vehicles/public pedestrian and light vehicle paths</td>
<td>3</td>
</tr>
<tr>
<td>Residential driveways — Commercial vehicles/public pedestrian and commercial vehicle paths</td>
<td>5</td>
</tr>
<tr>
<td>Regularly trafficked roads</td>
<td>6</td>
</tr>
<tr>
<td>Heavy duty/industrial roads</td>
<td>7</td>
</tr>
</tbody>
</table>
**Fig. 6** Method of Loading Test Specimen for Flexural Strength/Breaking Load

**Fig. 7** Loading of Common Irregular Shapes of Flexural Strength/Breaking Load Test
ANNEX H
(Clauses 6.3.3 and 7.3 and Table 4)
METHOD OF DETERMINATION OF FREEZE-THAW DURABILITY

H-1 SCOPE
This method covers the determination of the resistance of concrete paver blocks to repeated cycles of freezing and thawing when fully submerged in 3 percent sodium chloride solution.

H-2 APPARATUS
H-2.1 The freezing apparatus shall consist of a suitable cabinet or cold room with controls to reach and maintain an air temperature of \(-15 \pm 2\)°C within 1 h of the introduction of specimens.

H-2.2 The thawing chamber (cabinet or room) shall be suitable to maintain a controlled air temperature of \(23 \pm 3\)°C.

H-2.3 The moist chamber (cabinet or room) shall be suitable to maintain a controlled air temperature of \(23 \pm 2\)°C and a relative humidity of 90 percent. If storage in water is desirable, a saturated lime solution shall be used, and the temperature shall be maintained at \(23 \pm 2\)°C.

H-2.4 For measuring fine spalled material, a balance having a capacity of not less than 500 g sensitive to 0.1 g shall be used. For measuring the dry weight of paver blocks, a balance having a capacity of not less than 5 000 g sensitive to 1 g shall be used.

H-2.5 The drying oven shall be capable of being maintained at \(110 \pm 5\)°C, and the rate of evaporation shall average at least 25 g per hour. This rate shall be determined by the loss of water from 1 L Griffin low-form beakers, each containing 500 g of water at a temperature of \(23 \pm 2\)°C, placed at each corner and at the centre of each shelf of the oven, and heated for at least 4 h, during which period the doors of the oven shall be kept closed.

H-2.6 The containers shall be made of non-corroding material and have such dimensions as to permit complete submersion of the specimens in the saline solution.

H-3 SPECIMENS
The paver block specimens selected as per the sampling procedure in 8 and as per the number of specimens mentioned in Table 4 shall be tested.

H-4 PROCEDURE
H-4.1 The specimens shall be oven dried for not less than 24 h and until two successive weighing at intervals of 2 h show an increment of loss of not greater than 0.2 percent of the last previously determined weight of the specimen.

H-4.2 One freeze-thaw cycle shall be completed every 24 h. The cycle shall consist of 16 \(\pm 1\) h of freezing, followed by 8 \(\pm 1\) h of thawing. If for any reason a thaw period cannot commence at the specified time, the specimens shall remain in a frozen condition until conditions are suitable for resumption of the test.

H-4.3 Following the completion of the oven drying and cooling to room temperature, the specimens shall be placed in individual containers with the bottom surface of the specimens resting on the glass, stainless steel, ceramic, or plastic spacers (approximately 3 mm high) to ensure exposure of at least 95 percent of the bottom surfaces to the saline solution.

H-4.4 The containers shall be filled with a 3 percent sodium chloride solution at a temperature of \(23 \pm 3\)°C for 24 h. The level of the solution shall be at least 2 mm above the surface of the specimens, but excess volume of solution shall be avoided in order to ensure rapid freezing of the specimens.

H-4.5 Following the 24 h saturation period, the specimens shall be subjected to continuous freeze-thaw cycles as outlined in H-4.2.

H-4.6 After 10, 25 and 50 cycles the specimens shall be washed with 3 percent sodium chloride solution to remove all loose particles. These particles and spalled material, collected at the bottom of the containers, shall be washed, stained through a filter, and dried to constant weight. This residue shall be defined as weight loss and expressed as a percent of the initial dry weight of the specimens. The residue shall be cumulatively weighed after 10, 25 and 50 cycles.

H-4.7 A new solution of 3 percent sodium chloride shall be used following each weight loss determination. The 24 h pre-soaking period shall be waived at 10 and 25 cycles, provided that the specimens are maintained in a saturated condition during weight determinations.

H-5 CALCULATION
H-5.1 The weight loss shall be calculated to the nearest 0.01 percent.

H-5.2 The test shall continue until 50 freeze-thaw cycles have been completed unless the test specimens have disintegrated or lost more than 1.0 percent of their original dry weight. If, because of high spalling losses or disintegration, testing of the specimen has
to be terminated prematurely, the weight loss shall be determined (see H-4.6) and added to the previous lost weight.

H-6 REPORT
The report shall include the following:

a) Identification of specimens;
b) Dimensions;
c) Weight losses of the specimens and the average results after 10, 25 and 50 cycles or at the time of termination of the test;
d) Number of cycles at termination time;
e) Visual rating of the specimens after 10, 25 and 50 cycles in accordance with the following scale:
   1) 0 : no scaling;
   2) 1 : very slight scaling (3 mm depth maximum. No coarse aggregate visible);
   3) 2 : slight to moderate scaling;
   4) 3 : moderate scaling (some coarse aggregates visible on 50 percent of the surface);
   5) 4 : moderate to severe scaling (some coarse aggregates visible on 75 percent of the surface);
   6) 5 : severe scaling (coarse aggregates visible on 100 percent of the surface);
f) Description of the damages suffered by the specimens, and photographs where possible;
g) Manufacturer;
h) Date; and
j) Batch.

H-7 GUIDE FOR DURABILITY CHARACTERISTICS

H-7.1 As a guide to the purchaser, the durability characteristics given in H-7.2 may be adopted.

H-7.2 When tested in accordance with this method, the average weight loss of three paver blocks, after having been subjected to 50 freeze-thaw cycles while totally immersed in a 3 percent sodium chloride solution, shall not exceed 1.00 percent of the initial constant dry weight of the specimens.

ANNEX J
(Foreword)

COMMITTEE COMPOSITION
Flooring, Wall Finishing and Roofing Sectional Committee, CED 5

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Builder’s Association of India, New Delhi
Building Materials and Technology Promotion Council, New Delhi
Central Building Research Institute, Roorkee
Central Public Works Department, New Delhi
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IS 15658:2006

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Modern Tiles & Marble, New Delhi

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National Test House (NR), Kolkata

National Tiles Corporation, Panchkula

Premier Polyfilm Ltd, Ghaziabad

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Public Works Department, Chennai

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Research, Designs and Standards Organization, Lucknow

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In personal capacity (C-474B, Sushant Lok, Phase-I, Gurgaon-122002 (Haryana))

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This Indian Standard has been developed from Doc : No. CED 5 (7295).

Amendments Issued Since Publication

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Indian Standard
CHEQUERED CEMENT CONCRETE TILES — SPECIFICATION

UCD  666·972·431
AMENDMENT NO. 1 SEPTEMBER 1994
TO
IS 13801 : 1993 CHEQUERED CEMENT
CONCRETE TILES — SPECIFICATION

(Page 4, Annex E-3) — Substitute the following for the existing formula:

\[
\frac{M_1 - M_2}{M_2} \times 100
\]

(CED 5)

Reprography Unit, BIS, New Delhi, India
AMENDMENT NO. 2 APRIL 1999
TO
IS 13801 : 1993 CHEQUERED CEMENT CONCRETE
TILES — SPECIFICATION

(Please 1, clause 4.1) — Substitute the following for the existing clause:

'4.1 Cement

Cement used in the manufacture of tiles shall be 33 grade ordinary Portland
cement conforming to IS 269 : 1989 or rapid hardening Portland cement
conforming to IS 8041 : 1990 or white Portland cement conforming to IS 8042 :
1989 or Portland pozzolana cement (Fly ash based) conforming to
IS 1489 (Part 1) : 1991 and Portland pozzolana cement (calcined clay based)
conforming to IS 1489 (Part 2) : 1991.'

[Page 1, clause 4.3.1(c)] — Substitute 'IS 56 : 1993' for 'IS 56 : 1975'.

(Please 3, Annex A) — Substitute 'IS 56 : 1993 Prussian blue (iron blue)
for paints (second revision)' for 'IS 56 : 1975 Prussian blue (iron blue) for
paints (first revision)' and 'IS 3178 : 1996 Abrasive emery grain (first
revision)' for 'IS 3178 : 1965 Abrasive emery grain'.

(CED 5)
AMENDMENT NO. 3 MARCH 2002
TO
IS 13801 : 1993 CHEQUERED CEMENT CONCRETE TILES — SPECIFICATION

[ Page 1, clause 4.1, ( see also Amendment No. 2 ) ] — Insert the following at the end of the clause:

‘or 43 grade ordinary Portland cement conforming to IS 8112 : 1989 or 53 grade ordinary portland cement conforming to IS 12269 : 1989.’

( Page 5, clause G-1.2, last sentence ) — Substitute the following for the existing:

‘The surface to be tested shall be ground to remove the grouting/filling.’

( CED 5 )

Reprography Unit, BIS, New Delhi, India
AMENDMENT NO. 4 JUNE 2003 TO IS 13801:1993 CHEQUERED CEMENT CONCRETE TILES — SPECIFICATION

(Page 1, clause 3.1) — Substitute the following for the existing clause:

3.1 Chequered Tiles

Chequered tiles, cement tiles or terrazo tiles having grooves on the surface of the tile making it anti-slippery. The area of chequered grooves should not be less than 2 percent of the total surface area of the tile. The chequered groove can be in any shape and length, but the depth of grooves should not be less than 3 mm.

(CED 5) Reprography Unit, BIS, New Delhi, India
FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Flooring, Wall Finishing and Roofing Sectional Committee had been approved by the Civil Engineering Division Council.

Chequered cement concrete flooring tiles are used for footpaths, entrance and stair-cases of public buildings, passages of auditoriums and storage godowns, etc. Large number of cement concrete chequered tiles are being manufactured and used in our country. This standard is being formulated to provide necessary guidance to manufacturers and users of these tiles.

The size specified in the standard are the existing metric sizes which form the bulk of current production in the country. The concept of adopting dimensionally co-ordinated sizes is being excluded from this standard, however it is intended to incorporate them if the opportunity occurs during revision of the standard.

For the purpose of deciding whether the particular requirement of this standard, is complied with, the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off in accordance with IS 2:1960 'Rules for rounding off numerical values (revised)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

The composition of the committee responsible for the formulation of this standard is given at Annex H.
Indian Standard

CHEQUERED CEMENT CONCRETE TILES — SPECIFICATION

1 SCOPE

1.1 This standard covers chequered cement concrete flooring tiles.

2 REFERENCES

The Indian Standards listed in Annex A are necessary adjuncts to this standard.

3 TERMINOLOGY

3.0 For the purpose of this standard the following definition and those given in IS 1237:1980 shall apply.

3.1 Chequered Tiles

Chequered tiles are cement tiles or terrazzo tiles with the centre to centre distance of chequers not less than 25 mm and not more than 50 mm, the grooves in the chequers being uniform and straight with the depth of grooves not less than 3 mm.

4 MATERIALS

4.1 Cement

Cement used in the manufacture of tiles shall be ordinary Portland cement conforming to IS 269:1989 or rapid hardening Portland cement conforming to IS 269:1990 or white Portland cement conforming to IS 803:1991 or Portland pozzolana cement conforming to IS 1489 (Part 1) : 1976 and IS 1489 (Part 2) : 1991.

4.2 Aggregates

Aggregates used in the backing layer of tiles shall conform to the requirements of IS 383:1970. For the wearing layer, unless otherwise specified aggregates shall consist of marble chips or any other natural stone chips of similar characteristics and hardness, marble powder or dolomite powder or mixture of the two. Hardeners, if required may also be added.

4.3 Pigments

4.3.1 Pigments, synthetic or otherwise, used for colouring tiles shall have durable colour. It shall not contain matters detrimental to concrete and shall according to the colour required be one of the following or their combination:

<table>
<thead>
<tr>
<th>Pigments</th>
<th>Relevant Indian Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Black or red or brown pigments</td>
<td>IS 44:1991</td>
</tr>
<tr>
<td>b) Green pigments</td>
<td>IS 54:1983</td>
</tr>
<tr>
<td>c) Blue pigments</td>
<td>IS 55:1970 or IS 56:1975</td>
</tr>
<tr>
<td>d) White pigments</td>
<td>IS 411:1991 or IS 3574 (Part 2) : 1966</td>
</tr>
<tr>
<td>e) Yellow pigments</td>
<td>IS 50:1980 or IS 3574 (Part 1) : 1965</td>
</tr>
</tbody>
</table>

4.3.2 Colours other than mentioned above may also be used.

4.3.3 The pigments shall not contain zinc compounds organic dyes.

4.3.4 Lead pigments shall not be used unless otherwise specified by the purchaser.

5 MANUFACTURE

5.1 Chequered cement concrete flooring tiles shall be manufactured from a mixture of cement, natural aggregates, and colouring materials where required, by pressure process. During manufacture, the tile shall be subjected to a pressure of not less than 14 N/mm².

5.2 The proportion of cement to aggregate in the backing of the tiles shall be not leaner than 1 : 3 by mass.

5.3 Where colouring material is used in the wearing layer, it shall not exceed 10 percent by mass of cement used in the mix.

5.4 On removal from the mould, the tiles shall be kept in moist condition continuously for such a period that would ensure their conformity to the requirements of this standard. Tiles shall be stored under cover.
NOTE - The thickness shall be measured at two points situated approximately 50 mm from the ends on the fracture line of the tile that is tested for wet transverse strength. The total thickness is the arithmetic mean of these two measurements.

6.1.1 Half tiles rectangular in shape shall also be available. Half tiles for use with full tiles in the floor shall have dimensions which shall be such as to make two half tiles when joined together, to match with the dimensions of the one full tile.

7 TOLERANCES

7.1 Tolerances on length or breadth of tiles shall be ±1 mm. In addition, the difference in length of side between the longest side and the shorter side in the sample shall not exceed 1 mm.

7.2 Tolerance on thickness shall be +5 mm. In addition the difference in thickness between the thickest and the thinnest tile in the sample shall not exceed 3 mm.

7.3 Thickness of Wearing Layer

7.3.1 The thickness of wearing layer measured from the top of the chequers shall not be less than 6 mm.

7.3.2 The thickness of the wearing layer shall be measured at several points along the fracture line of the tile that was tested for wet transverse strength. The arithmetic mean of the two measurements which yielded the lowest value shall be the minimum thickness of the wearing layer.

8 SPECIAL SHAPE AND SIZE

8.1 Shapes and sizes of tiles other than those specified in 6.1 may be manufactured when agreed upon between the supplier and the purchaser but the depth of the grooves shall not be less than 3 mm. The tiles shall also meet all the requirements of the standard.

NOTE - In rectangular tiles, the requirements for the difference in the length of sides as specified in 7.1 shall be applicable both to the length and width of the tiles.

9 GENERAL QUALITY

9.1 Unless otherwise specified, the tiles shall be supplied with initial grinding and grouting of the upper layer. The upper layer of the tiles shall be free from projections, depressions, cracks (hair cracks not included), holes, cavities and other blemishes. The edges of the tile may be rounded.

10 FINISH

10.1 The colour and texture of the wearing layer shall be uniform throughout its thickness. No appreciable difference in the appearance of the tiles, from the point of view of colour of aggregate, its type and its distribution on the surface of the wiring layer shall be present.

11 PHYSICAL REQUIREMENT

11.0 The tests on tile shall not be carried out earlier than 28 days from the date of manufacture.

11.1 Flatness of the Tile Surface

The tiles when tested according to the procedure laid down in Annex B, the amount of concavity and convexity shall not exceed 1 mm.

11.2 Perpendicularity

When tested in accordance with the procedure laid down in Annex C, the longest gap between the arm of the 'square' and the edge of the tiles shall not exceed 2 percent of the length of the edge.

11.3 Straightness

When tested according to the procedure given in Annex D, the gap between the thread and the plane of the tile shall not exceed 1 percent of the length of the edge.

11.4 Water Absorption

When tested according to the procedure laid down in Annex E, the average percent of water absorption shall not exceed 10.

11.5 Wet Transverse Strength

When tested according to the procedure laid down in Annex F, the average wet transverse strength shall not be less than 3 N/mm².

11.6 Resistance to Wear

When tested in the manner specified in Annex G, the wear shall not exceed the following value:

a) Average wear 2 mm

b) Wear on individual specimen 2.5 mm

12 MARKING

12.1 Tiles shall be legibly and indelibly marked on the back with the identification of the source of manufacturer.
12.1.1 Each tile may also be marked with the Standard Mark.

13 PACKING
13.1 The tiles shall be packed according to the usual trade practice and adequately protected.

14 SAMPLING AND CRITERION FOR CONFORMITY
14.1 The consignment of chequered cement concrete flooring tiles shall be divided into a number of lots in accordance with 14.1.1. Each lot shall be inspected separately for ascertaining its conformity to the requirements of this specification.

14.1.1 Lot
All the chequered cement concrete flooring tiles in a consignment which are of same type, shape and size and manufactured by a single manufacturer from identical raw materials, under identical conditions of manufacture shall be grouped together to constitute a single lot.

14.2 The sample of tiles for inspection and testing shall be chosen from a lot at random. For guidance in procedure of random selection IS 4905 : 1968 may be referred.

14.3 Number of Samples and Criterion for Conformity
For each characteristic the number of sample tiles to be selected from a lot and the criterion for determining the conformity of the lot on the basis of the test results on those samples, shall be in accordance with inspection level 1 in Table 1 and AQL 6.5 percent in Table 3 of IS 2500 (Part 1) : 1992.

14.4 If the samples drawn for testing one characteristic can be utilized for testing any other characteristic, without introducing any prejudice in the test results of the latter, it would not be necessary to take fresh samples for the latter characteristics.

ANNEX A
(Clause 2.1)

LIST OF REFERRED INDIAN STANDARDS

<table>
<thead>
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<th>IS No.</th>
<th>Title</th>
<th>IS No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>44 : 1991</td>
<td>Iron oxide pigment for paints (second revision)</td>
<td>1489</td>
<td>Portland pozzolana cement : Calcined clay based (third revision)</td>
</tr>
<tr>
<td>50 : 1980</td>
<td>Lead and scarlet chrome (third revision)</td>
<td>2500</td>
<td>Sampling inspection tables : Part 1 Inspection by attributes and by count of defects (second revision)</td>
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<td>54 : 1988</td>
<td>Green oxide of chromium for paints (second revision)</td>
<td>3178 : 1965</td>
<td>Abrasive emery grain</td>
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<tr>
<td>55 : 1970</td>
<td>Ultramarine blue for paints (first revision)</td>
<td>3574</td>
<td>Organic pigments for paints : Part 1 Azo pigments</td>
</tr>
<tr>
<td>56 : 1975</td>
<td>Prussian blue (iron blue) for paints (first revision)</td>
<td>3574</td>
<td>Organic pigments for paints : Part 2 Phthalooyanines</td>
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<tr>
<td>269 : 1989</td>
<td>33 grade ordinary Portland cement (fourth revision)</td>
<td>4905 : 1968</td>
<td>Methods for random sampling</td>
</tr>
<tr>
<td>411 : 1991</td>
<td>Titanium dioxide, anatase, for paints (third revision)</td>
<td>8042 : 1989</td>
<td>White Portland cements (second revision)</td>
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<td>1237 : 1980</td>
<td>Cement concrete flooring tiles (first revision)</td>
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<td>1489</td>
<td>Portland pozzolana cement : Part 1 Fly ash based (third revision)</td>
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</table>

IS 13801 : 1993
ANNEX B
(Clause 11.1)

METHOD OF DETERMINATION OF FLATNESS OF TILE SURFACE

B-1 Six full size tiles selected in accordance with 14 shall be tested in the manner specified in B-2 to B-4.

B-2 The flatness of the tile surface is tested by means of a metal ruler, whose length is not less than the tile diagonal.

B-3 For testing surfaces that are concave, the ruler is placed on the surface of the tile along one of the diagonals so that the ruler touches the tile at not less than two points. The largest gap is measured and the test is repeated along the second diagonal. The larger gap is the amount of concavity.

B-4 For testing surfaces that are convex, the ruler is placed on the surface of the tile along one of the diagonals so that the distances between the ruler and the tile, at the ends of the diagonal, are equal. The largest gap is measured between the ruler and tile and the test is repeated along the second diagonal. The larger gap is the amount of convexity.

ANNEX C
(Clause 11.2)

METHOD OF THE DETERMINATION OF PERPENDICULARITY

C-1 Six full size tiles selected in accordance with 14 shall be tested in the manner specified in C-2.

C-2 One arm of a 'square', the arms of which are longer than the sides of the tile, is placed along one of the edges of the tile, so that the corner of the 'square' touches the corner of the tile. The distance between the other arm of the 'square' and the other edge is measured at the end of the tile. The test is repeated such that two opposite edges shall be tested.

C-3 The largest gap between the arm of the 'square' and the edge of the tile shall be reported.

ANNEX D
(Clause 11.3)

METHOD FOR DETERMINATION OF STRAIGHTNESS

D-1 Six full size tiles selected in accordance with 14 shall be tested in the manner specified in D-2.

D-2 Two corners of the tile surface shall be connected with a fine thread alongside one of the tile edges and the largest gap between the thread and the plane is recorded. The test is repeated alongside each of the other edges. The gap between the thread and the plain of the tile shall not exceed 1 percent of the edge length.

ANNEX E
(Clause 11.4)

METHOD FOR DETERMINATION OF WATER ABSORPTION

E-1 Six full size tiles selected in accordance with 14 shall be used for the test. They shall be immersed in water for 24 hours, then taken out and wiped dry.

E-2 Each tile shall be weighed immediately after saturation and wiping as in E-1. The tile shall then be dried to a constant weight in an oven maintained at 110 ± 5°C, cooled to room temperature and reweighted.

E-3 The water absorption for each tile shall be determined as follows:

\[
\text{Water absorption, percent by mass} = \left( \frac{M_1 - M_2}{M_1} \right) \times 100
\]

where

\( M_1 = \text{mass in g of the saturated specimen,} \) and

\( M_2 = \text{mass in g of the oven-dried specimen.} \)

E-4 The average value shall be reported.
ANNEX F
(Clause 11.5)

METHOD FOR DETERMINATION OF WET TRANSVERSE STRENGTH

F-1 Six full size tiles selected in accordance with 14 shall be tested wet after soaking in water for 24 hours.

F-2 The specimen shall be placed horizontally on two parallel steel supports, with wearing surface upwards and its sides parallel to the supports. At least one of the supports shall be self-adjusting.

F-3 The load shall be applied by means of a steel rod parallel to the supports and midway between them. The length of the supports and of the loading rod shall be longer than the tile. Their diameter shall be 12 mm. The surface of the rod and supports in contact with the tile shall be rounded. The span between the supports shall be as follows:

<table>
<thead>
<tr>
<th>Size of Tile (mm)</th>
<th>Span (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 x 200</td>
<td>150</td>
</tr>
<tr>
<td>250 x 250</td>
<td>200</td>
</tr>
<tr>
<td>300 x 300</td>
<td>250</td>
</tr>
</tbody>
</table>

F-4 A plywood padding about 3 mm thick and 20 mm wide shall be placed between the tile and each of the supports and between the tile and the steel rod. The length of the padding shall be at least as long as the tile.

F-5 The load shall be applied gradually and at a uniform rate not exceeding 2000 N per minute, until the tile breaks.

F-6 The load P which caused the breaking of the tiles shall be recorded. The thickness shall be determined as the average of two measurements at the location of the fracture, 50 mm from each edge (7.3). The wet transverse strength f shall be calculated as follows:

\[ f = \frac{3P}{2bI^2} \text{ N/mm}^3 \]

where

- \( P \) = breaking load in N,
- \( I \) = span between supports in mm,
- \( b \) = tile width in mm, and
- \( t \) = fracture thickness of the tiles measured from the fracture line in mm

F-7 The average wet transverse strength shall be reported.

ANNEX G
(Clause 11.6)

METHOD FOR DETERMINATION OF RESISTANCE TO WEAR

G-1 METHOD

G-1.1 Six full size tiles selected in accordance with 14 shall be tested in the manner specified in G-1.2 to G-1.5.

G-1.2 Preparation of Test Specimens

The test specimens shall be square in shape and of size 70.6 mm x 70.6 mm (that is, 500 mm² in area). They shall be sawn off one only from each tile, preferably from the central part of the tile. The deviation in the length of the specimen shall be within ±2 percent. The surface to be tested shall be ground smooth and filling removed.

G-1.3 Apparatus and Accessories

G-1.3.1 Abrasion Testing Machine

The abrasion of specimens shall be carried out in a machine conforming essentially to the requirement given in G-3.

G-1.3.2 The abrasive powder used for the test shall conform to the requirements given in G-3.

G-1.3.3 Measuring Instrument

A suitable instrument capable of measurements to an accuracy of 0.01 mm shall be used for determining the change in the thickness of the specimen after abrasion.

NOTES

1 The arrangement for measurement of thickness with the instrument may be as given in Fig. 1. Shoulders A and B are right angles and the base C is machined at top to an accuracy of 0.01 mm. The test specimen shall be placed on the base with its wearing surface upwards and sides in contact with the shoulders. The measuring instrument (or dial gauge) shall be set up firmly so that the contractor slightly presses on the surface of the specimen and the reading of the instrument taken. The position of the dial gauge and the sitting of the contractor shall be the same during the subsequent measurement after abrasion.

2 The measurement for thickness both before and after the test shall be taken at five points (one at the centre and four at the corners) as shown in Fig. 2.

G-1.4 Procedure of Test

The specimens shall be dried at 110 ± 5°C for 24 hours and then weighed to the nearest 0.1 g.
The specimen after initial drying and weighing shall be placed in the thickness-measuring apparatus (see Note I below G-1.3.3) with its wearing surface upwards and the reading of the measuring instrument taken.

G-1.4.1 The grinding path of the disc of the abrasion testing machine (see G-2) shall be evenly strewn with 20 g of the abrasive powder. The specimen shall then be fixed in the holding device with the surface to be ground facing the disc, and loaded at the centre with 300 N. The grinding disc shall then be put in motion at a speed of 30 rev/min and the abrasive powder is continuously fed back on to the grinding path so that it remains uniformly distributed in a track corresponding to the width of the test piece. After every 22 revolutions, the disc shall be stopped, the abraded tile powder and the remainder of the abrasive powder shall be removed from the disc, and fresh abrasive powder in quantities of 20 g applied each time. After every 22 revolution the specimen shall be turned about the vertical axis through an angle of 90° in the clockwise direction and it should be repeated 9 times thereby giving total number of revolutions of 220. The disc, the abrasive powder and the specimen shall be kept dry throughout the duration of the test. After the abrasion is over, the specimen shall be reweighed to the nearest 0.1 g. It shall then be placed in the thickness measuring apparatus once again in an identical manner and the reading taken with the same position and setting of the dial gauge as for the measurement before abrasion.

NOTE — If, after the specimen has been subjected to the abrasion test, it is found that the tile has chipped off at any of the points of measurement, that measurement should be discarded in calculating the average. However, a minimum of three residual measurements on a specimen should be ensured.
G-1.5 Determination of Wear

The wear shall be determined from the difference in readings obtained by the measuring instrument before and after the abrasion of the specimen. The value shall be checked up with the average loss in thickness of the specimen obtained by the following formula:

\[ t = \frac{W_1 - W_2}{V_1} \times A \]

where

- \( t \) = average loss in thickness in mm,
- \( W_1 \) = initial mass of the specimen in g,
- \( W_2 \) = final mass of the abraded specimen in g,
- \( V_1 \) = initial volume of the specimen in mm³, and
- \( A \) = surface area of the specimen in mm²

G-1.6 The average wear and the wear on individual specimens shall be reported.

G-2 ESSENTIAL REQUIREMENTS OF THE ABRASION TESTING MACHINE

G-2.1 General

The testing apparatus shall be a grinding device consisting essentially of a horizontally fixed smooth grinding disc of about 750 mm diameter rotating about a vertical axis and furnished with a replaceable grinding path. The essential features are shown in Fig. 3.

G-2.2 Grinding Path

G-2.2.1 Cast iron shall be used as the material for grinding path. Its scleroscope hardness shall lie between 30 and 50. This hardness shall be ascertained at least 10 times on the rim and at several points in the grinding path by means of a Shore's scleroscope with diamond hammer.

G-2.2.2 The grinding path shall be a 200 mm wide annular space on the grinding disc between distances of 120 and 320 mm from the centre. The grinding path shall be repaired and restored when it has worn out by more than 0.5 mm after use or when the furrows formed in it exceed 0.2 mm in depth. When the grinding path is restored, its hardness shall be determined afresh. When irreparable, it shall be changed.

G-2.3 Rotation Disc

The disc shall be driven at 30 revolutions per minute. The speed of rotation shall not deviate by more than one revolution per minute. There shall be automatic mechanisms for counting, indicating the revolutions of the disc and for stopping the disc after every 22 revolutions. Such mechanisms shall be checked for reliability prior to the test.

G-2.4 Holding Device for Test Specimen

The holding device shall consist of a square frame, open on one side and made of cast iron or steel, it shall be of about 40 mm height, with its lower edge about 5 mm above the surface of the grinding disc and so positioned that its centre is at a distance of 220 mm from the centre of the disc. It shall necessarily, but loosely, hold the specimen.

G-2.5 Loading Device

G-2.5.1 The loading device shall consist of a steel lever. A short arm of the lever shall be provided with a counter weight just to balance the weight of the long arm and of the weighing disc, so that the pressure stamp just touches the specimen prior to the loading.
G-2.5.2 The lever shall move freely about the fulcrum without appreciable friction. During test, the lever shall remain nearly parallel to the upper surface of the disc. The connection of the pressure stamp to the lever shall be through a self-aligning joint permitting free relative movement but at the same time ensuring a central load on the specimen being tested.

G-2.5.3 Suitable loading weight shall be applied at the end of the long arm of the lever so that, as magnified by the leverage, a net load of 300 N is applied through the pressure stamp on to the specimen. The load shall be applied with a permissible deviation of one percent. The accuracy of the load shall be verified both by calculation and by measurement with suitable instruments.

G-3 REQUIREMENT FOR ABRASIVE POWDER TO BE USED IN THE ABRASION TEST

G-3.1 Chemical Composition
G-3.1.1 The abrasive powder shall have a aluminium oxide content of not less than 95 percent by mass.

G-3.2 Shape and Size
The grains shall be of rounded shape. The size shall conform to the requirements given in Grit 60 of IS 3178 : 1965.

G-3.3 Specific Gravity
The specific gravity of the grains shall be between 3.9 to 4.1.

G-3.4 Hardness
The grains shall generally have a hardness of 9 in Moh's scale.

ANNEX H
( Foreword )

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</tr>
</thead>
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IS 1237 (2012): Cement Concrete Flooring Tiles - Specification [CED 5: Flooring, Wall Finishing and Roofing]
Indian Standard
CEMENT CONCRETE FLOORING TILES — SPECIFICATION
(Second Revision)

ICS 91.100.30
FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Flooring Wall Finishing and Roofing Sectional Committee had been approved by the Civil Engineering Division Council.

This standard was first published in 1959 and subsequently revised in 1985. In the first revision the permissible wear of tiles was increased and a larger wearing layer permitted. Method of measuring thickness of wearing layer was introduced. The first revision also incorporated modification in the method of test for abrasion resistance and the introduction of additional tests like flatness, perpendicularity and straightness. A new sampling plan was also introduced.

This revision has been undertaken to incorporate changes based on the experience gained in applying the provisions of the earlier version of the standard and the latest practices in the country. Cement concrete flooring tiles have traditionally been manufactured by pressure process. Some manufacturers have also manufactured the tiles by other processes such as vibration process, either alone or in combination with pressure process. This standard however leaves it to the manufacturer to adopt any process of manufacture. In this standard the following major changes have been incorporated:

a) Requirement on thickness of tiles including tolerances, have been redefined and minimum thicknesses specified separately for single layer/monolayer and double layer tiles, and
b) Additional tile size of 400 mm introduced.

In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country.

The composition of the Committee responsible for formulation of the standard is given in Annex H.

For the purpose of deciding whether a particular requirement of this standard, is complied with, the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (revised)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.
1 SCOPE
This standard covers cement concrete flooring tiles of plain cement, plain coloured and terrazo types.

NOTE — The provisions of this standard do not apply to chequered tiles.

2 REFERENCES
The standards listed in Annex A contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 TERMINOLOGY
For the purpose of this standard, the following definitions shall apply.

3.1 Plain Cement Tiles — Tiles having a plain wearing surface, in the manufacture of which pigments and stone chips are not used in the wearing surface.

3.2 Plain Coloured Tiles — Tiles having a plain wearing surface wherein pigments are used but not stone chips.

3.3 Terrazo Tiles — Tiles at least 25 percent of whose wearing surface is composed of stone chips in a matrix of plain or coloured Portland cement, mixed with or without pigments and mechanically ground and filled, if required.

3.4 Single Layer/Monolayer Tiles — Tiles, plain or terrazo, in which there is only one layer that is wearing layer, and which do not contain a backing layer.

3.5 Double Layer Tile — Tiles which contain a wearing layer as well as a backing layer.

4 CLASSIFICATION
Cement concrete flooring tiles shall be of two classes as given below depending on the duty they perform:

a) General Purpose Tiles — Used in such places where normally light loads are taken up by the floors; such as office buildings, schools, colleges, hospitals and residential buildings (usually indoor floors).

b) Heavy Duty Floor Tiles — Used for heavy traffic conditions; such as foot paths, ramps, entrances and staircases of public buildings, passages of auditoriums and storage godowns (public path or industrial floors).

5 MATERIALS

5.1 Cement
Cement used in the manufacture of tiles shall be 33 grade ordinary Portland cement conforming to IS 269 or 43 grade ordinary Portland cement conforming to IS 8112 or 53 grade ordinary Portland cement conforming to IS 12269 or Portland pozzolana cement (flyash based) conforming to IS 1489 (Part 1) or Portland pozzolana cement (calcined clay based) conforming to IS 1489 (Part 2) or Portland slag cement conforming to IS 455 or rapid hardening Portland cement conforming to IS 8041 or white Portland cement conforming to IS 8042.

5.2 Aggregates
Aggregates used in the backing layer of tiles shall conform to the requirements of IS 383. For the wearing layer, unless otherwise specified, aggregates shall consist of marble chips or any other natural stone chips of similar characteristics and hardness, marble powder or dolomite powder, or a mixture of the two.

5.3 Pigments
Pigments, synthetic or otherwise, used for colouring tiles shall have durable colour. It shall not contain matters detrimental to concrete and shall according to the colour required be one of the following or their combination:

<table>
<thead>
<tr>
<th>Pigments</th>
<th>Ref to IS No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black or red or brown</td>
<td>IS 44</td>
</tr>
<tr>
<td>Green pigments</td>
<td>IS 54</td>
</tr>
<tr>
<td>Blue pigments</td>
<td>IS 55 or IS 56 or IS 3574 (Part 2)</td>
</tr>
<tr>
<td>White pigments</td>
<td>IS 411</td>
</tr>
<tr>
<td>Yellow pigments</td>
<td>IS 50 or IS 3574 (Part 1)</td>
</tr>
</tbody>
</table>

5.3.1 Colours other than mentioned above may also be used.
5.3.2 The pigments shall not contain zinc compounds or organic dyes.

5.3.3 Lead pigments shall not be used unless otherwise specified by the purchaser.

6 MANUFACTURE

6.1 Cement concrete flooring tiles shall be manufactured from a mixture of cement, natural aggregates and colouring material where required, by pressure process (with or without vacuum dewatering) or vibration (with or without vacuum dewatering) or a combination of both, so that the tiles meet the requirements specified in the standard.

NOTE — When manufactured by pressure process alone, the tiles shall be subjected to a pressure of not less than 14 N/mm².

6.2 The tiles shall be manufactured in single layer/monolayer or in double layer.

6.3 The proportion of cement to aggregate in the backing of the double layer tiles shall be not leaner than 1:3 by mass. Single layer/monolayer tiles shall have only the wearing layer.

6.4 Where colouring material is used in the wearing layer, it shall not exceed 10 percent by mass of cement used in the mix.

6.5 On removal from the mould, the tiles shall be kept in moist condition continuously for such a period that would ensure their conformity to the requirements of this standard. Tiles shall be stored under cover.

7 DIMENSIONS

7.1 The size of cement concrete flooring tiles shall be as given in Table 1.

Table 1 Size of Cement Concrete Flooring Tiles

<table>
<thead>
<tr>
<th>S1 No.</th>
<th>Length (mm)</th>
<th>Breadth (mm)</th>
<th>Minimum Thickness (mm)</th>
<th>Single Layer or Monolayer Tile</th>
<th>Double Layer Tile</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td></td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>i)</td>
<td>200</td>
<td>200</td>
<td>10</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>ii)</td>
<td>250</td>
<td>250</td>
<td>12</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>iii)</td>
<td>300</td>
<td>300</td>
<td>14</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>iv)</td>
<td>400</td>
<td>400</td>
<td>16</td>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>

NOTE — The thickness shall be measured at two points situated approximately 50 mm from the ends on the fracture line of the tile that was tested for wet transverse strength according to 12.6. The total thickness is the arithmetic mean of these two measurements.

7.1.1 Half tiles rectangular in shape shall also be available. Half tiles for use with full tiles in the floor shall have dimensions which shall be such as to make two half tiles when joined together match with the dimensions of the one full tile.

8 TOLERANCES

8.1 Tolerances on length or breadth of tiles shall be ±1 mm. In addition, the difference in length between the longest side and the shortest side in the sample shall not exceed 1 mm.

8.2 Tolerance on thickness shall be +15 percent of the minimum thickness (no tolerance on the negative side shall be permitted). In addition, the difference in thickness between the thickest and the thinnest tile in the sample shall not exceed 10 percent of the minimum thickness.

8.3 Thickness of Wearing Layer of Double Layer Tiles

8.3.1 The minimum thickness of wearing layer for the various classes of double layer cement concrete flooring tiles shall be as specified in Table 2.

Table 2 Thickness of Wearing Layer for Double Layer Tiles

<table>
<thead>
<tr>
<th>S1 No. (1)</th>
<th>Class of Tile (2)</th>
<th>Minimum Thickness of Wearing Layer for Double Layer Tile (3) mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>i)</td>
<td>Plain cement and plain coloured tiles, for general purpose</td>
<td>5</td>
</tr>
<tr>
<td>ii)</td>
<td>Terrazo tiles with chips of size varying from the smallest up to 6 mm, for general purpose</td>
<td>5</td>
</tr>
<tr>
<td>iii)</td>
<td>Terrazo tiles with chips of size varying from the smallest up to 12 mm, for general purpose</td>
<td>5</td>
</tr>
<tr>
<td>iv)</td>
<td>Terrazo tiles with chips of size varying from the smallest up to 20 mm, for general purpose</td>
<td>6</td>
</tr>
<tr>
<td>v)</td>
<td>Plain cement and plain coloured tiles, for heavy duty</td>
<td>6</td>
</tr>
<tr>
<td>vi)</td>
<td>Terrazo tiles with chips of size varying from the smallest up to 20 mm, for heavy duty</td>
<td>6</td>
</tr>
</tbody>
</table>

8.3.2 The thickness of the wearing layer for double layer tiles shall be measured at several points along the fracture line of the tile that was tested for wet transverse strength in accordance with 12.6. The arithmetic mean of the two measurements which yielded the lowest value shall be the minimum thickness of the wearing layer.

9 SPECIAL SHAPE AND SIZE

Shapes and sizes of tiles other than those specified in 7.1 may be manufactured when agreed upon between the supplier and the purchaser, provided that the tiles meet all other requirements of the standard.
NOTE — In rectangular tiles, the requirements for the difference in the length of sides as specified in 8.1 shall be applicable both to the length and width of the tiles.

10 GENERAL QUALITY

Unless otherwise specified, the tiles shall be supplied with initial grinding and grouting of the wearing layer. The wearing layer of the tiles shall be free from projections, depressions, cracks (hair cracks not included), holes, cavities and other blemishes. The edges of the wearing layer may be rounded.

11 FINISH

11.1 The colour and texture of the wearing layer shall be uniform throughout its thickness. No appreciable difference in the appearance of the tiles, from the point of view of colour of aggregate, its type and its distribution on the surface of the wearing layer shall be present.

NOTES

1 When indenting for plain cement and plain coloured tiles, the purchaser should specify the colour. It should be noted that due to the nature of the product, the range of colours for flooring tiles is limited and the tiles may not be produced to match all the colours. Purchasers are recommended to consult the manufacturers while selecting the colours of tiles which they wish to procure.

2 Exact matching of the shade of the colour may not always be possible in actual manufacture. There may be some variations in colour in different batches due to variations in the basic colour of raw materials.

11.2 When indenting for terrazo tile, the purchaser shall state the size of chips to be used in the wearing layer.

NOTE — It is recommended that the purchaser should consult the design cards of the manufacturers while specifying the size of chips. It is hardly possible to cover the colour for terrazo tiles in a comprehensive chart since numerous colour compositions are possible. The colour patterns will not only vary with the colour used but also with the sizes of chips and their distribution, and its choice is left to the mutual agreement between the purchaser and the supplier.

12 PHYSICAL REQUIREMENTS

12.1 The tests on tile shall not be carried out earlier than 28 days from the date of manufacture.

12.2 Flatness of the Tile Surface

When tested in accordance with the procedure laid down in Annex B, the concavity and convexity in the tiles shall not exceed 1 mm.

12.3 Perpendicularity

When tested in accordance with the procedure laid down in Annex C, the maximum gap between the arm of the square and the edge of the tile shall not exceed 2 percent of the length of the edge of the tile.

12.4 Straightness

When tested in accordance with the procedure given in Annex D, the gap between the thread and the plane of the tile shall not exceed 1 percent of the length of the edge of the tile.

12.5 Water Absorption

When tested in accordance with the procedure laid down in Annex E, the average percentage of water absorption shall not exceed 10.

12.6 Wet Transverse Strength

When tested in accordance with the procedure laid down in Annex F, the average wet transverse strength shall not be less than 3 N/mm².

12.7 Resistance to Wear

When tested in the manner specified in Annex G, the wear shall not exceed the following values:

- For general purpose floor tiles:
  1) Average wear : 3.5 mm
  2) Wear on individual specimen : 4 mm
- For heavy duty floor tiles:
  1) Average wear : 2 mm
  2) Wear on individual specimen : 2.5 mm

13 MARKING

13.1 Tiles shall be legibly marked on the back with the name of the manufacturer or his trade-mark. Heavy duty tiles shall be marked ‘H’.

13.2 BIS Certification Marking

Each tile may also be marked with the Standard Mark.

13.2.1 The use of the Standard Mark is governed by the provision of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers, may be obtained from the Bureau of Indian Standards.

14 PACKING

The tiles shall be packed according to the usual trade practice and adequately protected.

15 SAMPLING AND CRITERION FOR CONFORMITY

15.1 The consignment of cement concrete flooring tiles shall be divided into a number of lots in accordance with 15.1.1. Each lot shall be inspected separately for ascertaining its conformity to the requirements of this standard.
15.1.1 Lot

All the cement concrete flooring tiles in a consignment which are of same type, class, shape and size and have been manufactured by a single manufacturer from identical raw material, under identical conditions of manufacture shall be grouped together to constitute a single lot.

15.2 The sample tiles for inspection and testing shall be chosen from a lot at random. For guidance in procedure of random selection IS 4905 may be referred.

15.3 Number of Samples and Criterion for Conformity

For each characteristic the number of sample tiles to be selected from a lot and the criterion for determining the conformity of the lot on the basis of the test results on those samples, shall be in accordance with inspection level I in Table 1 and AQL 6.5 percent in Table 3 of IS 2500 (Part 1).

15.4 If the samples drawn for testing one characteristic can be utilized for testing any other characteristic, without introducing any prejudice in the test results of the latter, it would not be necessary to take fresh samples for the latter characteristics.

ANNEX A

(CLause 2)

LIST OF REFERRED INDIAN STANDARDS

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<thead>
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<th>Title</th>
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<td>Specification for green oxide of chromium for paints (second revision)</td>
<td>2500 (Part 1) : 2000</td>
<td>Sampling inspection procedures: Part 1 Attribute sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection (third revision)</td>
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<td>55 : 1970</td>
<td>Specification for ultramarine blue for paints (first revision)</td>
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<td>Specification for organic pigments for paints:</td>
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<tr>
<td>56 : 1993</td>
<td>Specification for Prussian blue (iron blue) for paints (second revision)</td>
<td>(Part 1) : 1965</td>
<td>AZO pigments (Toluidine red.bmp chlorinated p-Nitroaniline red, arylamide yellows; and para red)</td>
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</table>
ANNEX B
(Clause 12.2)

METHOD FOR DETERMINATION OF FLATNESS OF TILE SURFACE

B-1 Six full size tiles selected in accordance with 15 shall be tested in the manner specified in B-2 to B-4.

B-2 The flatness of the tile surface is tested by means of a metal ruler, whose length is not less than the tile diagonal.

B-3 For testing surfaces that are concave, the ruler is placed on the surface of the tile along one of the diagonals so that the ruler touches the tile at not less than two points. The largest gap is measured and the test is repeated along the second diagonal. The larger gap is the amount of concavity.

B-4 For testing surfaces that are convex, the ruler is placed on the surface of the tile along one of the diagonals so that the distances between the ruler and the tile, at the ends of the diagonal, are equal. The largest gap is measured between the ruler and the tile and the test is repeated along the second diagonal. The larger gap is the amount of convexity.

ANNEX C
(Clause 12.3)

METHOD FOR DETERMINATION OF PERPENDICULARITY

C-1 Six full size tiles selected in accordance with 15 shall be tested in the manner specified in C-2.

C-2 One arm of a square, the arms of which are longer than the sides of the tile, is placed along one of the edges of the tile, so that the corner of the square touches the corner of the tile. The distance between the other arm of the square and the other edge is measured at the end of the tile. The test is repeated such that two opposite edges shall be tested.

C-3 The largest gap between the arm of the square and the edge of the tile shall be reported.

ANNEX D
(Clause 12.4)

METHOD FOR DETERMINATION OF STRAIGHTNESS

D-1 Six full size tiles selected in accordance with 15 shall be tested in the manner specified in D-2.

D-2 Two corners of the tile surface shall be connected with a fine thread alongside one of the tile edges and the largest gap between the thread and the plane is recorded. The test is repeated alongside each of the other edges. The gap between the thread and the plane of the tile shall not exceed 1 percent of the edge length.

ANNEX E
(Clause 12.5)

METHOD FOR DETERMINATION OF WATER ABSORPTION

E-1 Six full size tiles selected in accordance with 15 shall be used for the test. They shall be immersed in water for 24 h, then taken out and wiped dry.

E-2 Each tile shall be weighed immediately after saturation and wiping as in E-1. The tile shall then be oven-dried at a temperature of 65 ± 1°C for a period of 24 h, cooled to room temperature and reweighed.

E-3 The water absorption for each tile shall be determined as follows:

\[
\text{Water absorption, percent by mass} = \frac{M_1 - M_2}{M_2} \times 100
\]

where

\[
M_1 = \text{mass of the saturated specimen, in g; and}
\]

\[
M_2 = \text{mass of the oven-dried specimen, in g.}
\]

E-4 The average value shall be reported.
ANNEX F  
(Clauses 12.6)

METHOD FOR DETERMINATION OF WET TRANSVERSE STRENGTH  

F-1 Six full size tiles selected in accordance with 15 shall be tested wet after soaking in water for 24 h.

F-2 The specimen shall be placed horizontally on two parallel steel supports, with wearing surface upwards and its sides parallel to the supports. At least one of the supports shall be self-adjusting. The load shall be applied by means of a steel rod parallel to the supports and midway between them. The length of the supports and of the loading rod shall be longer than the tile. Their diameter shall be 12 mm. The surface of the rod and supports in contact with the tile shall be rounded. The span between the supports shall be as follows:

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<tr>
<th>Size of Tile (mm)</th>
<th>Span (mm)</th>
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<tr>
<td>200 × 200</td>
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<tr>
<td>250 × 250</td>
<td>200</td>
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<tr>
<td>300 × 300</td>
<td>250</td>
</tr>
<tr>
<td>400 × 400</td>
<td>350</td>
</tr>
</tbody>
</table>

A plywood padding about 3 mm thick and 20 mm wide shall be placed between the tile and each of the supports and between the tile and the steel rod. The length of the padding shall be at least as long as the tile. The load shall be applied gradually and at a uniform rate not exceeding 2 000 N/min, until the tile breaks.

F-3 The load \( P \) which caused the breaking of the tile shall be recorded. The thickness \( t \) shall be determined as the average of two measurements at the location of the fracture, 50 mm from each edge (see 8.3). The wet transverse strength \( f \) shall be calculated as follows:

\[
f = \frac{3P_I}{2bt} \text{ N/mm}^2
\]

where
- \( P \) = breaking load, in N;
- \( I \) = span between supports, in mm;
- \( b \) = tile width, in mm; and
- \( t \) = tile thickness, in mm.

F-4 The average wet transverse strength shall be reported.

ANNEX G  
(Clauses 12.7)

METHOD FOR DETERMINATION OF RESISTANCE TO WEAR  

G-1 METHOD  

G-1.1 Six full size tiles selected in accordance with 15 shall be tested in the manner specified in G-1.2 to G-1.5.

G-1.2 Preparation of Test Specimens  

The test specimens shall be square in shape and of size 70.6 mm × 70.6 mm (that is, 5 000 mm² in area). They shall be sawn off one only from each tile, preferably from the central part of the tile. The deviation in the length of the specimen shall be within ±2 percent. The surface to be tested shall be ground smooth and filling removed.

G-1.3 Apparatus and Accessories  

G-1.3.1 Abrasion Testing Machine  

The abrasion of specimens shall be carried out in a machine conforming essentially to the requirements described in G-2.

G-1.3.2 The abrasive powder used for the test shall conform to the requirements given in G-3.

G-1.3.3 Measuring Instrument  

A suitable instrument capable of measurements to an accuracy of 0.01 mm shall be used for determining the change in the thickness of the specimen after abrasion.

NOTES  

1 The arrangement for measurement of thickness with the instrument may be as given in Fig. 1. Shoulders \( A \) and \( B \) are at right angles and the base \( C \) is machined at top to an accuracy of 0.01 mm. The test specimen shall be placed on the base with its wearing surface upwards and sides in contact with the shoulders. The measuring instrument (or dial gauge) shall be set up firmly so that the contactor slightly presses on the surface of the specimen and the reading of the instrument taken. The position of the dial gauge and the sitting of the contactor shall be the same, during the subsequent measurement after abrasion.

2 The measurement for thickness both before and after the test, shall be taken at five points (one at the centre and four at the corners) as shown in Fig. 2.
G-1.4 Procedure of Test

The specimens shall be dried at 110 ± 5°C for 24 h and then weighed to the nearest 0.1 g. The specimen after initial drying and weighing shall be placed in the thickness-measuring apparatus (see Note 1 under G-1.3.3) with its wearing surface upwards and the reading of the measuring instrument taken.

G-1.4.1 The grinding path of the disc of the abrasion testing machine (see G-2) shall be evenly strewn with 20 g of the abrasive powder. The specimen shall then be fixed in the holding device with the surface to be ground facing the disc, and loaded at the centre with 300 N. The grinding disc shall then be put in motion at a speed of 30 rev/min and the abrasive powder is continuously fed back on to the grinding path so that it remains uniformly distributed in a track corresponding to the width of the test piece. After every 22 revolutions, the disc shall be stopped, the abraded tile powder and the remainder of the abrasive powder shall be removed from the disc and fresh abrasive powder in quantities of 20 g applied each time. After every 22 revolutions the specimen shall be turned about the vertical axis through an angle of

All dimensions in millimetres.

FIG. 1 ARRANGEMENT FOR MEASUREMENT OF THICKNESS

FIG. 2 POINT SHOWING MEASUREMENT OF THICKNESS
90° in the clockwise direction and it should be repeated 9 times thereby giving total number of revolutions of 220. The disc, the abrasive powder and the specimen shall be kept dry throughout the duration of the test. After the abrasion is over, the specimen shall be reweighed to the nearest 0.1 g. It shall then be placed in the thickness measuring apparatus once again in an identical manner and the reading taken with the same position and setting of the dial gauge as for the measurement before abrasion.

NOTE — If, after the specimen has been subjected to the abrasion test, it is found that the tile has chipped off at any of the points of measurement, that measurement should be discarded in calculating the average. However, a minimum of three residual measurements on a specimen should be ensured.

G-1.5 Determination of Wear

The wear shall be determined from the difference in readings obtained by the measuring instrument before and after the abrasion of the specimen. The value shall be checked up with the average loss in thickness of the specimen obtained by the following formula:

\[
t = \frac{(W_1-W_2)}{V_1 A}
\]

where

- \( t \) = average loss in thickness, in mm;
- \( W_1 \) = initial mass of the specimen, in g;
- \( W_2 \) = final mass of the abraded specimen, in g;
- \( V_1 \) = initial volume of the specimen, in mm³;
- \( A \) = surface area of the specimen, in mm².

G-1.6 The average wear and the wear on individual specimens shall be reported.

G-2 ESSENTIAL REQUIREMENTS OF THE ABRASION TESTING MACHINE

G-2.1 General

The testing apparatus shall be a grinding device consisting essentially of a horizontally fixed smooth grinding disc of about 750 mm diameter, rotating about a vertical axis and furnished with a replaceable grinding path. The essential features are shown in Fig. 3.

G-2.2 Grinding Path

G-2.2.1 Cast iron shall be used as the material for grinding path. Its scaleroscope hardness shall lie between 30 and 50. This hardness shall be ascertained at least 10 times on the rim and at several points in the grinding path by means of a Shore’s scaleroscope with diamond hammer.

G-2.2.2 The grinding path shall be a 200 mm wide annular space on the grinding disc between distances of 120 mm and 320 mm from the centre. The grinding path shall be repaired and restored when it has worn out by more than 0.5 mm after use or when the furrows formed in it exceed 0.2 mm in depth. When the grinding path is restored, its hardness shall be determined afresh. When irreparable it shall be changed.

G-2.3 Rotation Disc

The disc shall be driven at 30 rev/min. The speed of rotation shall not deviate by more than 1 rev/min. There shall be automatic mechanisms for counting, indicating the revolutions of the disc and for stopping the disc after every 22 revolutions. Such mechanisms shall be checked for reliability prior to the test.

All dimensions in millimetres.

FIG. 3 GENERAL FEATURES OF ABRASION TESTING MACHINES
G-2.4 Holding Device for Test Specimen
The holding device shall consist of a square frame, open on one side and made of cast iron or steel; it shall be of about 40 mm height, with its lower edge about 5 mm above the surface of the grinding disc and so positioned that its centre is at a distance of 220 mm from the centre of the disc. It shall necessarily, but loosely, hold the specimen.

G-2.5 Loading Device
G-2.5.1 The loading device shall consist of a steel lever. A short arm of the lever shall be provided with a counter weight just to balance the weight of the long arm and of the weighing disc, so that the pressure stamp just touches the specimen prior to the loading.
G-2.5.2 The lever shall move freely about the fulcrum without appreciable friction. During test, the lever shall remain nearly parallel to the upper surface of the disc. The connection of the pressure stamp to the lever shall be through a self-aligning joint permitting free relative movement but at the same time ensuring a central load on the specimen being tested.

G-2.5.3 Suitable loading weight shall be applied at the end of the long arm of the lever so that, as magnified by the leverage, a net load of 300 N is applied through the pressure stamp on to the specimen. The load shall be applied with a permissible deviation of 1 percent. The accuracy of the load shall be verified both by calculation and by measurement with suitable instruments.

G-3 REQUIREMENT FOR ABRASIVE POWDER TO BE USED IN THE ABRASION TEST

G-3.1 Chemical Composition
G-3.1.1 The abrasive powder shall have an aluminium oxide content of not less than 95 percent by mass.

G-3.2 Shape and Size
The grains shall be of rounded shape. The size shall conform to the requirements given in Table 3.

G-3.3 Specific Gravity
The specific gravity of the grains shall be between 3.9 to 4.1.

G-3.4 Hardness
The grains shall generally have a hardness of 9 in Moh’s scale.

<table>
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<tr>
<th>Sl No.</th>
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<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>i)</td>
<td>Retained on 355 micron IS Sieve</td>
<td>Nil</td>
</tr>
<tr>
<td>ii)</td>
<td>Retained on 250 micron IS Sieve</td>
<td>0-15</td>
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<tr>
<td>iii)</td>
<td>Retained on 212 micron IS Sieve</td>
<td>45, Min</td>
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<tr>
<td>iv)</td>
<td>Retained on 212 and 180 micron IS Sieve</td>
<td>70, Min</td>
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<tr>
<td>v)</td>
<td>Passing 150 micron IS Sieve</td>
<td>3, Max</td>
</tr>
</tbody>
</table>

Table 3 Requirements for Size

ANNEX H
(Foreword)

COMMITTEE COMPOSITION
Flooring Wall Finishing and Roofing Sectional Committee, CED 5

Organization
Institution of Engineers (India), New Delhi
Border Roads Organization, New Delhi
Building Materials & Technology Promotion Council, New Delhi
Carborundum Universal Limited, Chennai
Central Building Research Institute, Roorkee
Central Glass & Ceramic Research Institute, Naroda
Central Public Works Department, New Delhi
Central Road Research Institute, New Delhi

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SIRI P. B. VIJAY (Chairman)
SIRI U. K. PANDEY
SIRI S. K. GUPTA
SIRI PANKAJ GUPTA (Alternate)
SIRI R. RAJAGOPALAN
DR P. SACHINDRAPAL (Alternate)
SIRI B. K. RAO
SIRI ACHAL KUMAR MITTAL (Alternate)

Central Glass & Ceramic Research Institute, Naroda

CENTRAL PUBLIC WORKS DEPARTMENT, NEW DELHI
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<th>Representative(s)</th>
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<tr>
<td>Construction Industry Development Council, New Delhi</td>
<td>SHRI P. R. SWARUP (Alternate)</td>
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<td>Delhi Development Authority, New Delhi</td>
<td>CHIEF ENGINEER</td>
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<td>Dyna Bricks (I) Pvt Ltd, Noida</td>
<td>SUPERINTENDING ENGINEER (P) (Alternate)</td>
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<td>Engineer-in-Chief’s Branch, New Delhi</td>
<td>SHRI ASHUTOSHI DEKSHIT</td>
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<td>Engineers India Limited, New Delhi</td>
<td>SHRI RAVI JAIN (Alternate)</td>
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<tr>
<td>Grasim Industries Limited, Mumbai</td>
<td>SHRI J. K. BHAGCHANDANI (Alternate)</td>
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<tr>
<td>Gujarat Ceramic Floor Tiles Manufacturers Association, Morbi</td>
<td>SHRI S. MAJUMDAR (Alternate)</td>
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<tr>
<td>H. R. Johnson (India) Limited, Mumbai</td>
<td>SHRI P. K. RAY (Alternate)</td>
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<td>Indian Council of Ceramic Tiles &amp; Sanitaryware, New Delhi</td>
<td>SHRI BHAWNESH KUMAR (Alternate)</td>
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<td>Indian Institute of Technology, New Delhi</td>
<td>SHRI VELIBHAI K. PATEL (Alternate)</td>
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<td>Lloyd Insulation (India) Pvt Limited, New Delhi</td>
<td>SHRI PANCHANBHAI M. PATEL (Alternate)</td>
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<td>Masonry Producer Association of India, Chennai</td>
<td>SHRI G. S. PATNAIK (Alternate)</td>
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<td>Modern Tiles &amp; Marble, New Delhi</td>
<td>SHRI ABHINU RAO (Alternate)</td>
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<td>Mumbai Municipal Corporation, Mumbai</td>
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<td>National Council for Cement and Building Materials, Ballabgarh</td>
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<td>Research, Designs and Standards Organization, Lucknow</td>
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<td>Shiriram Institute of Industrial Research, New Delhi</td>
<td>SHRI R. K. NARAD (Alternate)</td>
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<tr>
<td>Super Tiles &amp; Marble Pvt Ltd, Mumbai</td>
<td>EXECUTIVE ENGINEER (P&amp;D II) (Alternate)</td>
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<td>In personal capacity (C-474 B, Sushant Lok, Phase I, Gurgaon)</td>
<td>EXECUTIVE ENGINEER (P&amp;D I) (Alternate)</td>
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<tr>
<td>BIS Directorate General</td>
<td>SHRI N. C. SAUNDERS (Alternate)</td>
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**Member Secretary**

J. ROY CHOWDHURY
Scientist ‘E’ (CED), BIS
Bureau of Indian Standards

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Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of ‘BIS Catalogue’ and ‘Standards: Monthly Additions’.

This Indian Standard has been developed from Doc No.: CED 5 (7605).

Amendments Issued Since Publication

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BUREAU OF INDIAN STANDARDS

Headquarters:
Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402 Website: www.bis.org.in

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<td>2323 7617, 2323 3841</td>
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<td>Eastern</td>
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<td>SCO 335-336, Sector 34-A, CHANDIGARH 160022</td>
<td>260 3843, 260 9285</td>
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<td>C.I.T. Campus, IV Cross Road, CHENNAI 600113</td>
<td>2254 1216, 2254 1442</td>
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Published by BIS, New Delhi