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Indian Standard

CYCLES — LIGHTING AND RETRO-REFLECTIVE DEVICES — PHOTOMETRIC AND PHYSICAL REQUIREMENTS

PART 2 RETRO-REFLECTIVE DEVICES

ICS 43.150

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

May 2009

Price Group 4
NATIONAL FOREWORD

This Indian Standard (Part 2) which is identical with ISO 6742/2-1985 ‘Cycles — Lighting and retro-reflective devices — Photometric and physical requirements — Part 2: Retro-reflective devices’ issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Bicycle Sectional Committee and approval of the Transport Engineering Division Council.

This standard was earlier published as IS 7699 : 1975 'Specification for reflex reflectors for cycles'. In order to harmonize the standard with International Standard, the Committee decided to adopt ISO 6742-1 and ISO 6742-2. With the publication of these standards IS 7699 : 1975 shall be withdrawn.

This standard specifies photometric and physical requirements for retro-reflective devices for fitting to cycles intended to be used on public roads. Such retro-reflective devices are effective in conditions of poor visibility and at night in helping to make all road users aware of the presence of a cyclist.

The text of ISO Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker in the International Standard while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their respective places are listed below along with their degree of equivalence for the editions indicated:

<table>
<thead>
<tr>
<th>International Standard</th>
<th>Corresponding Indian Standard</th>
<th>Degree of Equivalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 3768 Metallic coatings — Neutral salt spray test (NSS test)</td>
<td>IS 9844 : 1981 Methods of testing corrosion resistance of electroplated and anodized aluminium coatings by neutral salt spray test</td>
<td>Technically Equivalent</td>
</tr>
</tbody>
</table>

The technical committee responsible for the preparation of this standard has reviewed the provisions of the following International Standards referred in this adopted standard and has decided that they are acceptable for use in conjunction with this standard:

<table>
<thead>
<tr>
<th>International Standard</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC Publication No. 50(45)</td>
<td>International Electrotechnical Vocabulary — Lighting</td>
</tr>
<tr>
<td>CIE Publication No. 15</td>
<td>Colorimetry: Official recommendations of the International Commission on illumination (CIE)</td>
</tr>
</tbody>
</table>

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Indian Standard

CYCLES — LIGHTING AND RETRO-REFLECTIVE DEVICES — PHOTOMETRIC AND PHYSICAL REQUIREMENTS

PART 2 RETRO-REFLECTIVE DEVICES

0 Introduction

In producing this part of ISO 6742, the aim has been to specify requirements for retro-reflective devices fitted to cycles so that in conditions of poor visibility and at night, such devices are effective in helping to make all road users aware of the presence of a cyclist.

ISO 6742/1 specifies requirements for lighting equipment.

1 Scope and field of application

This part of ISO 6742 specifies photometric and physical requirements for retro-reflective devices for fitting to cycles intended to be used on public roads and, in particular, for use on cycles made in compliance with ISO 4210.

2 References

ISO 3798, Metallic coatings — Neutral salt spray test (NSS test).

ISO 4210, Cycles — Safety requirements of bicycles.

IEC Publication No. 50(45), International Electrotechnical Vocabulary — Lighting.


3 Definitions

For the purposes of this part of ISO 6742, the definitions given below, together with those in IEC Publication No. 50(45) apply.

3.1 retro-reflective device; reflector: An assembly ready for use and comprising one or more retro-reflecting optical units.

3.2 wide angle reflector: Device providing retro-reflection through horizontal entrance angles of not less than 50° on either side of the reference axis.

3.3 conventional reflector: Device providing retro-reflection through horizontal entrance angles of not less than 20° on either side of the reference axis.
Symbols and units used (see figure 1)

NOTE - The following symbols are in accordance with regulation No. 3 of the UNECE concerning retro-reflecting devices.

- \( A \) : area of the effective reflex surface of the retro-reflecting device, in square centimetres.
- \( C \) : reference centre.
- \( NC \) : reference axis.
- \( R \) : receiver, observer or measuring device.
- \( C_R \) : centre of receiver.
- \( \phi_R \) : diameter of receiver \( R \), if circular, in centimetres.
- \( S_a \) : source of illumination.
- \( C_S \) : centre of source of illumination.
- \( \phi_S \) : diameter of source of illumination, in centimetres.
- \( D_e \) : distance from centre \( C_s \) to centre \( C \), in metres.
- \( D'_e \) : distance from centre \( C_R \) to centre \( C \), in metres.

\( D \) : mean diameter of retro-reflective annulus on retro-reflecting tyres, in millimetres.

\( \alpha \) : observation angle.

\( \beta \) : entrance angle. With respect to the line \( C_S C \), which is always considered to be horizontal, this angle is prefixed with signs: \( - \) (left), \( + \) (right), \( + \) (up) or \( - \) (down), according to the position of the source \( S_a \) in relation to the axis \( NC \), as seen when looking towards the retro-reflecting device. For any direction defined by two angles, vertical and horizontal, the vertical angle is always given first.

\( \gamma \) : angular subtense of the measuring device \( R \), as seen from point \( C \).

\( \delta \) : angular subtense of the source \( S_a \), as seen from point \( C \).

\( \varepsilon \) : rotation angle. This angle is positive when the rotation is clockwise as seen when looking towards the illuminated surface. If the reflecting device is marked 'TOP', the position thus indicated is taken as the origin.

NOTE - All angles are expressed in degrees and minutes.

\( E \) : illuminance of the retro-reflecting device, in lux.

\( CIL \) : coefficient of luminous intensity, in millicandelas per lux.

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1 Document E/ECE 324 — E/ECE/TRANS/505 — Addendum 2/Revision 1, Regulation No. 3: Uniform provisions concerning the approval of reflex reflecting devices for power-driven vehicles and their trailers.
5 Photometric requirements

5.1 Refectors

When tested by the method given in clause 8, the CIL values for reflectors shall not be less than those specified in table 1 or 2.

Table 1 applies to front, side and rear reflectors. Values given are for clear (white) reflectors. Values for yellow reflectors shall be 5/8 × clear values. Values for red reflectors shall be 1/4 × clear values.

Table 2 applies to pedal reflectors.

5.2 Retro-reflective tyres

When tested by the method given in clause 9, the CIL values for a retro-reflective tyre shall be not less than those specified in table 3. In the case where D is less than 420 mm the minimum photometric value for each observation and entrance angle shall be equal to the value for D = 420 mm.

Table 1 — Coefficients of luminous intensity, CIL, for clear reflectors

<table>
<thead>
<tr>
<th>Observation angle, ( \alpha )</th>
<th>Entrance angle, ( \beta )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vertical : 0</td>
</tr>
<tr>
<td>Either 0° 12' or 0° 20'</td>
<td>2 500</td>
</tr>
<tr>
<td></td>
<td>1 800</td>
</tr>
<tr>
<td>1° 30'</td>
<td>26</td>
</tr>
</tbody>
</table>

NOTE — Values for entrance angles of \( \pm 30 \), \( \pm 40 \) and \( \pm 50^\circ \) are not applicable to conventional reflectors.

Table 2 — Coefficients of luminous intensity, CIL, for yellow pedal reflectors

<table>
<thead>
<tr>
<th>Observation angle, ( \alpha )</th>
<th>Entrance angle, ( \beta )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vertical : 0</td>
</tr>
<tr>
<td>Either 0° 12' or 0° 20'</td>
<td>450</td>
</tr>
<tr>
<td></td>
<td>325</td>
</tr>
<tr>
<td>1° 30'</td>
<td>16,5</td>
</tr>
</tbody>
</table>

Table 3 — Coefficients of luminous intensity, CIL, for retro-reflective tyres

<table>
<thead>
<tr>
<th>Observation angle, ( \alpha )</th>
<th>Entrance angle, ( \beta )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-4°</td>
</tr>
<tr>
<td>Either 0° 12' or 0° 20'</td>
<td>1,21</td>
</tr>
<tr>
<td>1° 30'</td>
<td>0,121</td>
</tr>
</tbody>
</table>
6 Colorimetric requirements

When determined by the method given in clause 10, the colour of the reflected light shall be located within the appropriate area defined by the CIE chromaticity coordinates specified in Table 4.

NOTE — For ease of reference these areas are shown graphically in Figure 2.

Table 4 — x-y chromaticity coordinates of the intersection points of colour boundary lines

<table>
<thead>
<tr>
<th>Colour</th>
<th>Coordinates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>x 0.665 0.645 0.721 0.736</td>
</tr>
<tr>
<td></td>
<td>y 0.335 0.335 0.259 0.265</td>
</tr>
<tr>
<td>Yellow</td>
<td>x 0.560 0.546 0.612 0.618</td>
</tr>
<tr>
<td></td>
<td>y 0.440 0.426 0.382 0.382</td>
</tr>
<tr>
<td>White</td>
<td>x 0.295 0.453 0.500 0.500 0.440 0.285</td>
</tr>
<tr>
<td></td>
<td>y 0.332 0.440 0.440 0.382 0.382 0.284</td>
</tr>
<tr>
<td>White/yellow</td>
<td>x 0.380 0.509 0.618 0.440 0.380</td>
</tr>
<tr>
<td></td>
<td>y 0.408 0.490 0.382 0.382 0.337</td>
</tr>
</tbody>
</table>

1) For retro-reflective tyres only.

Figure 2 — Boundaries of colour areas for reflective devices
7 Physical requirements

7.1 Reflectors

7.1.1 Construction

The reflector and/or mount shall incorporate a distinct preferred assembly method to ensure that the reflector can be mounted in its designed orientation with regard to the bicycle.

7.1.2 Tests

7.1.2.1 General

A reflector shall comply with the photometric and colorimetric requirements of 5.1 and 6, and there shall be no loosening of the mounting(s) or distortion of the housing that would affect the performance of the reflector, after being subjected to any or all of the tests specified in 7.1.2.2 to 7.1.2.8.

7.1.2.2 Temperature resistance test

When tested by the following method, a reflector shall exhibit no noticeable defects.

Place the reflector in a pre-heated oven for a minimum period of 1 h at a temperature of 50 ± 5 °C.

NOTE - A pedal reflector may be tested integrally with its pedal.

7.1.2.3 Impact test

When a reflector is tested at room temperature by the following method the lens shall not crack.

Mount the reflector in a manner similar to the way in which it is mounted on the bicycle, but with the lens face horizontal and directed upwards.

Drop a 13 mm diameter polished solid steel ball, once, vertically onto the central part of the lens from a height of 0.76 m. The ball may be guided but not restricted in free fall.

NOTE - Pedal reflectors are exempt from this requirement.

7.1.2.4 Moisture resistance test

Strip all removable parts from the reflective device, whether part of a lamp or not, and immerse for 10 min in water at a temperature of 50 ± 5 °C, the highest point of the upper part of the reflective surface being 20 mm below the surface of the water. Repeat this test after turning the reflective device through 180° so that the reflective surface is at the bottom and the rear face is covered by about 20 mm of water. Then immediately immerse the optical unit in the same conditions in water at a temperature of 25 ± 5 °C.

7.1.2.5 Reflector mount alignment test

When tested by the following method, the optical axis of the reflector (excluding pedal reflectors or spoke-mounted reflectors) shall not deflect more than 15° during the test, and shall not exhibit a permanent displacement greater than 5° after the test.

With the reflector and mount assembled to a rigid fixture duplicating the mating component or frame member for which it is designed and intended for use (including a rigidly mounted bicycle), apply a force of 90 N to the reflector unit in at least three directions selected as most likely to affect its alignment.

7.1.2.6 Resistance to corrosion

After being tested by the method specified in ISO 3768 the reflector shall not exhibit any visible signs of corrosion liable to affect the integrity of the mounting or housing.

The duration of the test shall be 50 h comprising two periods of exposure of 24 h each, separated by an interval of 2 h during which the sample is allowed to dry.

7.1.2.7 Resistance to fuels

Soak the outer surface of the reflector in a mixture of 70 % of n-heptane and 30 % toluene (by volume) After 5 min clean the surface by washing in a detergent solution and rinse in clean water.

7.1.2.8 Resistance to lubricating oils

Wipe the outer surface of the reflex reflector lightly with cotton soaked in a detergent lubricating oil. After 5 min clean the surface by washing in a detergent solution and rinse in clean water.

7.2 Retro-reflective tyres

7.2.1 Form and location

The retro-reflective strip shall be in the form of a continuous circle of retro-reflective material on each sidewall of the tyre.

7.2.2 Tests

7.2.2.1 General

When subjected to the tests in 7.2.2.2 to 7.2.2.9 inclusive, the retro-reflective material on the tyre shall comply with the photometric requirements of 5.2 for φ = 0° 12° or 0° 20° and β = -4°, and with the colorimetric requirements of clause 6, as specified in table 5.

The table also indicates where a portion of a tyre shall be used instead of a complete tyre. The portion shall be cut from a tyre not previously subjected to the physical tests of this part of ISO 6742. The requirements of 5.2 and 6 do not apply to a portion cut from a tyre.
### Table 5 — Applicability of specimens to the photometric and colorimetric requirements

<table>
<thead>
<tr>
<th>Test in clause</th>
<th>Tyre or portion to be used</th>
<th>Photometric requirements apply</th>
<th>Colorimetric requirements apply</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.2.2.2</td>
<td>Tyre</td>
<td>Yes, as in table 3</td>
<td>Yes</td>
</tr>
<tr>
<td>7.2.2.3</td>
<td>Portion</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>7.2.2.4</td>
<td>Portion</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>7.2.2.5</td>
<td>Portion</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>7.2.2.6</td>
<td>Tyre</td>
<td>Yes, see 7.2.2.6</td>
<td>Yes</td>
</tr>
<tr>
<td>7.2.2.7</td>
<td>Tyre</td>
<td>Yes, as in table 3</td>
<td>Yes</td>
</tr>
<tr>
<td>7.2.2.8</td>
<td>Tyre</td>
<td>Yes, as in table 3</td>
<td>Yes</td>
</tr>
<tr>
<td>7.2.2.9</td>
<td>Tyre</td>
<td>Yes, see 7.2.2.9</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### 7.2.2.2 Temperature resistance

When tested by the following method, there shall be no cracking, peeling or blistering of the retro-reflective material that would affect the performance for the intended use:

Subject a test sample to the following conditions in sequence:

- a) 12 h consecutively at a temperature of 65 ± 5 °C with a relative humidity of 10 ± 5 %;
- b) at least 1 h at a temperature of 23 ± 5 °C and 50 ± 10 % relative humidity;
- c) 15 h consecutively at a temperature of -20 ± 5 °C.

### 7.2.2.3 Adhesion

The retro-reflective material shall adhere to the tyre in such a way that, when conditioned and tested as described, a greater force than that specified shall be required to remove it from the substrate, or the material shall break when an attempt is made to remove it.

Condition the test sample for 30 min at a temperature of 50 ± 5 °C and then for 30 min at 23 ± 5 °C.

With a sharp knife, separate a strip of the retro-reflective material from the tyre.

Apply a tensile force of 1 N per millimetre of width of the strip in a direction normal to the strip to attempt to separate it from the substrate.

### 7.2.2.4 Abrasion resistance

The retro-reflective material shall be as resistant to abrasion as is the adjacent tyre material so that when retro-reflective material is removed from the inflated tyre by abrasion with a wet, steel-bristle brush, tyre material will be removed with the retro-reflective material.

### 7.2.2.5 Impact resistance

When tested by the following method the retro-reflective material shall show no cracking or separation from the tyre outside a distance of half the width of the material from the point of impact.

Condition the test sample for 1 h at -20 ± 5 °C. Immediately after removal from the cold storage, place the sample on a solid support base and subject the retro-reflective area to an impact from a 25 mm diameter solid steel ball dropped from a height of 2 m.

### 7.2.2.6 Resistance to corrosion

After being tested by the method specified in ISO 3788 there shall be no evidence of corrosion of the retro-reflective material that would result in failure to meet 75 % of the CIL values in table 3, at α = 0° 12' or 0° 20' and β = -4°.

The duration of the test shall be 50 h comprising two periods of exposure of 24 h each, separated by an interval of 2 h during which time the sample is allowed to dry.

### 7.2.2.7 Resistance to fuel

Lightly rub the retro-reflective area of the test sample with a cotton cloth soaked in a test fuel composed of 70 % n-heptane and 30 % toluene (by volume).

After 5 min clean the retro-reflective area by washing in a detergent solution and rinse in clean water.

### 7.2.2.8 Resistance to lubricating oil

Lightly rub the retro-reflective area of the test sample with a cotton cloth soaked in a detergent lubricating oil. After 5 min wipe the area clean with a mild aliphatic solvent such as heptane and follow by washing with a neutral detergent and rinsing in clean water.

### 7.2.2.9 Water test

Immerse the test sample for 1 min in water at a temperature of 23 ± 5 °C. 30 s after removal measure the CIL value for α = 0° 12' or 0° 20' and β = -4°. The CIL value shall not be less than 50 % of the minimum value in 3.2.

### 8 Photometric test for reflectors

#### 8.1 Principle

The coefficient of luminous intensity, CIL, is determined by the measurement of the illuminance at the test piece and the luminous intensity in the direction considered by means of appropriately calibrated photometers.

#### 8.2 Instrumentation arrangement

For measuring reflective devices the general arrangement of the instrumentation shall be as shown in figure 3, with the receiver positioned vertically above the light source. However, for measuring the photometric performance of reflective devices with microspheres the receiver can alternatively be positioned alongside the source in the same horizontal plane.
8.2 Source of illumination

8.3.1 The source of illumination shall approximate to Illuminant A as defined by CIE Publication No 15, and shall be stable.

8.3.2 The shape and size of the aperture shall be selected in relation to the receiver aperture, the observation distance and the range of devices to be tested.

The angular aperture of the source seen from the reference centre of the reflector shall be 10° maximum.

8.4 Receiver

8.4.1 The receiver shall have the relative spectral response of the CIE 1931 Standard Colorimetric Observer.

8.4.2 The angular aperture of the receiver seen from the reference centre of the reflector shall be 10° maximum.

8.5 Observation distance

The observation distance shall be 10 m minimum, or the optical equivalent.

8.6 Reflector mount (or support)

8.6.1 The reflector under test shall be mounted on a goniometer, or other suitable support, to provide the required entrance angles.

The retro reflector support shall be such that the horizontal entrance angles are obtained by rotating the reflector around a mobile vertical axis; vertical angles by rotating around a fixed horizontal axis.

8.6.2 The centre of the reflex area shall be located at the centre of rotation, and shall lie on the axis passing through the centre of the light source when \( \beta = 0/0 \).

8.7 Test area of reflector

For photometric measurements, the maximum area of the reflector to be exposed and projected on a plane perpendicular to its reference axis shall be 80 cm\(^2\) contained within a circle of diameter of 250 mm.

8.8 Illuminance at the reflector

Illuminence at the reflector shall be uniform within 5% of the mean of the complete area of the reflector.
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.
9.3 Orientation of reflector

9.3.1 Reflectors shall be tested in the orientation in which they are designed to be used.

Spoke reflectors shall be tested in the single orientation that provides the best overall performance.

9.3.2 Should uncoloured reflections from the front surface interfere with the photometric readings at any test point, the reflector may be rotated around its vertical or horizontal axis through an angle not exceeding 4°.

9 Photometric test for retro-reflective tyres

9.1 Instrumentation arrangement

The general arrangement of the instrumentation shall be as shown in figure 3 except that the receiver may be positioned alongside the source in the same horizontal plane.

9.2 Source of illumination

9.2.1 The source of illumination shall approximate to illuminant A as defined by CIE Publication No. 15, and shall be stable.

9.2.2 The effective lens diameter shall not exceed \( D_e / 500 \), where \( D_e \) is the distance from the source to the reflector.

9.3 Receiver

9.3.1 The receiver shall have the relative spectral response of the CIE 1931 Standard Colorimetric Observer.

9.3.2 The dimensions of the active area of the receiver shall be such that no point on the perimeter of the receiver is more than \( D_e / 1000 \) from its centre, where \( D_e \) is the distance from the source to the reflector.

9.4 Illuminance and observation distances

The distance between the source and the centre of the wheel, and between the receiver and the centre of the wheel, shall each be not less than 10 m.

9.5 Illuminance at the reflector

Measure the illuminance incident on the retro-reflective strip at uniform intervals of no more than 45° around the wheel with the receiver oriented in the direction of incident radiation. The average of such readings will be the mean illuminance of the sample. If any one of such readings differs by more than 10 % from the mean illuminance, then a more uniform source shall be obtained.

9.6 Test method

9.6.1 For testing the retro-reflective material on a tyre, the tyre shall be mounted on a wheel and inflated to the maximum pressure recommended by the manufacturer.

9.6.2 The retro-reflective strip on each side of the tyre shall be tested.

9.6.3 Measure the illuminance of the receiver due to retro-reflection for the entrance and observation angles given in table 3.

NOTE — A positive entrance angle corresponds to the case in which the line of sight to the receiver lies between the line of incidence and the optic axis of the retro-reflective strip, and a negative entrance angle corresponds to the case in which the line of incidence lies between the line of sight of the receiver and the optic axis of the retro-reflective strip.

10 Colorimetric test

10.1 Instrumental measurements

The chromaticity coordinates shall be determined for the condition \( \alpha = 0° \), \( \beta = 0° \) by means of a spectrophotometer or colorimeter. The test specimen shall be illuminated by a source of CIE Illuminant A. Sound calibration procedures and precautions shall be observed. In particular, if a colorimeter is used it shall be calibrated with standard colour sources whose spectral characteristics are closely related to those of the test samples. If standard colour surfaces having glossy or retro-reflective surfaces are used, they shall have been calibrated with the same instrument geometry.

10.2 Visual comparison

The colour of the test specimen illuminated as in 10.1 shall be compared with one of the following:

a) an acceptable reflector illuminated and viewed under the same conditions;

b) a self-luminous source of similar luminance whose colour coordinates are within the area specified in table 4.

The viewing area shall be shielded from extraneous light, preferably by a permanent structure. The background and surroundings of the enclosure shall have a low-gloss dark neutral surface. The test specimen and the comparison piece shall be contiguous.

10.3 Use of methods

Instrumental measurements shall be made for the calibration of control and comparison samples, and acceptance of new products. Visual comparison methods shall be restricted to batch testing against control samples.

11 Marking

Each retro-reflective device shall be durably marked with:

a) the number of this part of ISO 6742, i.e. ISO 6742/2; 

b) the manufacturer's name or trade-mark.

Marking a) shall appear on the front of the illuminating surface, or on one of the illuminating surfaces, in characters not less than 1 mm in height.
Bureau of Indian Standards

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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.: TED 16 (665).

Amendments Issued Since Publication

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<thead>
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</thead>
</table>

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