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

SELF-BALLASTED LED LAMPS FOR GENERAL LIGHTING SERVICES

PART 2 PERFORMANCE REQUIREMENTS

ICS 29.140.99
FOREWORD

This Indian Standard (Part 2) was adopted by the Bureau of Indian Standards, after the draft finalized by the Electric Lamps and Their Auxiliaries Sectional Committee had been approved by the Electrotechnical Division Council.

This standard specifies the performance requirements for self ballasted lamps for general lighting services for d.c. supplies up to 250 V or a.c. supplies up to 1 000 V at 50 Hz.

This standard is published in two parts. The other part in the series is:

   Part 1    Safety requirements

There will be and are already LED products in the market which substitute existing lamps, either as retrofit mains voltage incandescent or self ballasted fluorescent lamps or as replacement for tungsten halogen lamps below 50 V.

This standard is based on IEC 62612 ‘Self-ballasted LED lamps for general lighting services for voltage above 50 V — Performance requirements’ issued by the International Electrotechnical Commission (IEC) with following modifications:

   a) Made applicable for d.c. supplies up to 250 V or a.c. supplies up to 1 000 V at 50 Hz;
   b) Schedule of type test and acceptance test has been incorporated;
   c) Ambient test condition changed to 27°C;
   d) Selection of samples incorporated;
   e) Conditions of compliances incorporated;
   f) In Table 2 data related chromaticity co-ordinates and CCT values for 5 700 K added;
   g) Requirements of harmonics and p.f. have been added; and
   h) Tolerance for lamp power (see 8) increased to 15 percent and for luminous flux (see 9) decreased to 90 percent.

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.
INDIAN STANDARD

SELF-BALLASTED LED LAMPS FOR GENERAL LIGHTING SERVICES

PART 2 PERFORMANCE REQUIREMENTS

1 SCOPE

This standard (Part 2) specifies the performance requirements for self-ballasted LED lamps with a d.c. supplies up to 250 V or a.c. supplies up to 1 000 V at 50 Hz, together with the test methods and conditions, required to show compliance with this standard, intended for domestic and similar general lighting purposes, having,

a) a rated wattage up to 60 W;

b) a rated d.c. supplies up to 250 V or a.c. supplies up to 1 000 V at 50 Hz; and

c) a lamp cap according to IS 16102 (Part 1): 2012 ‘Self-ballasted LED lamps for general lighting services: Part 1 Safety requirements’.

This standard does not cover self-ballasted LED-lamps that intentionally produce tinted or coloured light neither does it cover OLEDs.

When applied for replacement purposes, the only dimensional feature provided by the standard is information on maximum lamp outlines.

Recommendations for batch testing are under consideration.

These performance requirements are additional to the requirements given in IS 16102 (Part 1).

NOTES

1 When operated in a luminaire the claimed performance data can deviate from the values established in this standard.

2 Higher wattage lamp is under consideration.

It may be expected that self-ballasted LED lamps, which comply with this standard will start and operate satisfactorily at voltages between 90 percent and 110 percent of rated supply voltage and at an ambient air temperature of between –10°C and 50°C and in a luminaire complying with IS 10322 (Part 1): 2012 ‘General requirements and tests for luminaires’.

NOTE — When the lamps are used in the luminaire, the ambient temperature inside the luminaire is expected to be higher than the room ambient temperature. The procedure for design and measurement is covered in IS 10322 (Part 1).

2 REFERENCES

The standards listed below 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 listed as follows:

<table>
<thead>
<tr>
<th>IS No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1885</td>
<td>Electrotechnical vocabulary: Part 16 Lighting, Section 1 General aspects</td>
</tr>
<tr>
<td>2418</td>
<td>Tubular fluorescent lamps for general lighting services: Part 1 Requirements and tests</td>
</tr>
<tr>
<td>6873</td>
<td>Limits and methods of measurement of radio disturbance characteristics: Part 5 Electrical lighting and similar equipment</td>
</tr>
<tr>
<td>14700</td>
<td>Electromagnetic compatibility: Part 3 Limits, Section 2 Limits for harmonic current emissions</td>
</tr>
<tr>
<td>15687</td>
<td>Single-capped fluorescent lamps: Part 1 Safety requirements</td>
</tr>
<tr>
<td>16102</td>
<td>General lighting — LEDs and LED modules — Terms and definitions</td>
</tr>
<tr>
<td>16106</td>
<td>Method for the electrical and photometric measurements of solid-state lighting products</td>
</tr>
<tr>
<td>CIE 1931</td>
<td>MacAdam ellipses as normally applied for (compact) fluorescent lamps and other discharge lamps</td>
</tr>
</tbody>
</table>

3 TERMINOLOGY

The definitions given in IS 16101, IS 1885 (Part 16/ Sec 1) and the following shall apply.

3.1 Rated Value — Quantity value for a characteristic of a LED lamp for specific operating conditions. The value and the conditions are specified in this standard, or assigned by the manufacturer or responsible vendor.

3.2 Test Voltage — Voltage at which tests are carried out.

3.3 Lumen Maintenance ($L_m$) — Luminous flux at a given time in the life of a led lamp divided by the initial
value of the luminous flux of the lamp and expressed as a percentage $x$ of the initial luminous flux.

NOTE — The lumen maintenance of a LED lamp is the effect of decrease of the lumen output of the LED(s) or a combination of this with failure(s) of LED(s) if the lamp contains more than one LED.

3.4 Initial Values — Photometric and electrical characteristics at the end of the ageing period and/or stabilization time.

3.5 Life (of an Individual LED Lamp) — Length of time during which a LED lamp provides more than 70 percent of the initial luminous flux, under standard test conditions. A LED lamp has thus reached its end of life, when it no longer provides 70 percent of the initial luminous flux. Life is always published in combination with the failure rate (see Note 3.7).

NOTES

1 LED lamps have a different end of life characteristic than conventional lamps, because typically they rather will dim over time in a gradual way than being subject to sudden lamp failure. Lumen maintenance is the governing characteristic for lifetime of LED lamps.

2 The built-in control gear and LED’s (with a certain probability), however, may show a sudden end of life failure. For self-ballasted LED lamps, the failure fraction expresses the combined effect of LED and control gear failure.

3 The maximum reduction of lumen maintenance may vary depending on the application of the LED lamp: This standard uses a value of 70 percent ($L_{70}$) as an example. Dedicated information on the chosen percentage is to be provided by the manufacturer.

4 End of lamp life is normally determined when 50 percent of the lamps failed, indicated in combination with the chosen lumen maintenance, for example: $L_{50}, F_{70}$. For professional applications, the combined value $L_{50}, F_{70}$ is advised, meaning maximum 10 percent of the lamps has failed when the point of 70 percent lumen maintenance has been reached.

3.6 Rated Lamp Life (h) — Length of time during which a LED lamp provides more than 70 percent of the rated luminous flux, published in combination with the failure rate, as declared by the manufacturer or responsible vendor.

NOTES

1 For sample size, see 7.

2 Notes 1, 2 and 4 of 3.5 shall apply.

3.7 Failure Fraction ($F_x$) — The percentage $x$ of a number of tested lamps of the same type, that have reached the end of their individual lives. For marking of the failure fraction (see Table 1).

NOTES

1 For self-ballasted LED lamps, the failure fraction expresses the combined effect of LED and control gear failure.

2 For self-ballasted LED lamps normally a failure fraction of 10 percent or/and 50 percent are being applied, indicated as $F_{10}$ and/or $F_{50}$.

3.8 Colour Code — Colour designation of a LED lamp giving white light is defined by the correlated colour temperature (CCT) and the colour rendition index. Attached to this, information is given on CCT tolerance category and life time category.

NOTES

1 An example of the construction of the colour code is given in Table 1.

2 The term general colour rendering index (CRI) is referred to CIE. The term colour rendition index designates one digit derived from the CRI (see Table 1).

3.9 Stabilization Time — Time which the LED lamp requires to obtain stable thermal conditions.

3.10 Ageing — Preconditioning period of the LED-lamps.

3.11 Type — Lamps that, independent of the type of cap, have an identical photometric and electrical rating.

3.12 Type Test — Test or series of tests made on a type test sample for the purpose of checking compliance of the design of a given product with the requirements of the relevant standard.

3.13 Type Test Sample — Sample consisting of one or more similar units submitted by the manufacturer or responsible vendor for the purpose of the type test.

3.14 Acceptance Test — Tests carried out on samples taken from a lot for the acceptance of the lot.

3.15 Batch — All the lamps of one type put forward at one time for acceptance test.

3.16 Inspection Test Quantity (ITQ) — The number of lamps selected for the purpose of determining the acceptability of a batch as to safety requirements given in Part 1 of this standard.

3.17 Rating Test Quantity (RTQ) — The number of lamps selected for the purpose of determining the acceptability of a batch as to safety requirements given in Part 1 of this standard.

3.18 Life Test Quantity (LTQ) — The number of lamps selected for the purpose of determining the acceptability of a batch as to life performance.

4 GENERAL REQUIREMENTS

These performance requirements are additional to the requirements given in IS 16102 (Part 1).

For measurement of lamp characteristics, see Annex A and Annex B.

5 MARKING

5.1 General Requirements for Marking

For this performance standard the following data are to be provided visible in addition to the mandatory data of IS 16102 (Part 1) by the manufacturer or responsible vendor, and placed as specified in Table 1.
5.2 BIS Certification Marking

The self-ballasted LED lamps may also be marked with the Standard Mark.

5.2.1 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 the licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

6 DIMENSIONS

The LED lamp dimensions shall comply with the requirements as indicated by the manufacturer or responsible vendor. If it is intended to replace an existing lamp with a LED lamp, then the maximum outlines shall not exceed those of the lamp that is replaced.

If the lamp power, the luminaire itself or any covering (if applicable) do not limit the use of not outline exceeding LED lamps, those lamps are also suitable regarding performance.

7 TEST CONDITIONS

Where in the standard a testing time of 6 000 h is required and the same result can be achieved with a short-term test of at least ‘x’ h, this is a valid option, provided that 6 000 h test is conducted in parallel and in case of doubt the result is drawn at the end of the 6 000 h testing period by the manufacturer or responsible vendor

(‘x’ under consideration)

Test conditions for testing electrical and photometric characteristics, lumen maintenance and life are given in Annex A.

All tests, except 13.2, are made on ‘n’ lamps. The number ‘n’ is declared by the manufacturer or responsible vendor, but shall be a minimum of 20 lamps. For 13.2, further 20 lamps are tested.

8 LAMP POWER

The initial power consumed by each LED lamp in the measured sample shall not exceed the rated power by more than 15 percent, and a 97.5 percent one sided upper confidence interval about the sample average, x, of lamp power shall contain the rated power value.

The 97.5 percent confidence interval may be approximated by the following formula:

\[ x + \left( 1.96 \frac{s}{\sqrt{n}} \right) \]

where x, s and n are the sample average, standard deviation and number of lamps respectively.

NOTE — Confidence level or condition of compliance and method of test is under consideration.

9 LUMINOUS FLUX

To comply with this standard, the initial luminous flux of each LED lamp in the measured sample shall not be less than 90 percent of the rated luminous flux, and a 97.5 percent one sided lower confidence interval about the sample average, x, of lamp luminous flux shall contain the rated luminous flux value. The 97.5 percent confidence interval may be approximated by the formula:

\[ x - \left( 1.96 \frac{s}{\sqrt{n}} \right) \]
where \( x \), \( s \) and \( n \) are the sample average, standard deviation and number of lamps respectively.

For marking of the rated luminous flux (see Table 1). For method of measurement of luminous flux (see Annex B).

NOTE — Confidence level or condition of compliance and method of test is under consideration.

10 CENTRE BEAM INTENSITY

To comply with this standard, the initial centre beam intensity of each LED lamp in the measured sample shall not be less than 75 percent of the rated centre beam intensity, and a 97.5 percent one sided lower confidence interval about the sample average, \( x \), of centre beam intensity shall contain the rated centre beam intensity value. The 97.5 percent confidence interval may be approximated by the formula:

\[
\bar{x} - \left( 1.96 \cdot \frac{s}{\sqrt{n}} \right)
\]

where \( x \), \( s \) and \( n \) are the sample average, standard deviation and number of lamps respectively.

For marking of the rated centre beam intensity (see Table 1).

NOTE — Confidence level or condition of compliance and method of test is under consideration.

11 BEAM ANGLE

To comply with this standard, the initial beam angle of each LED lamp in the measured sample shall be within ±25 percent of the rated beam angle, and a 95 percent confidence interval about the sample average, \( x \), of beam angle shall contain the rated beam angle value. The 95 percent confidence interval may be approximated by the formula:

\[
\bar{x} \pm \left( 1.96 \cdot \frac{s}{\sqrt{n}} \right)
\]

where \( x \), \( s \) and \( n \) are the sample average, standard deviation and number of lamps respectively.

For marking of the rated beam angle (see Table 1).

NOTE — Confidence level or condition of compliance and method of test is under consideration.

12 COLOUR NOMENCLATURE, VARIATION AND RENDERING

12.1 Colour Variation Categories

The rated colour of a lamp shall preferably be one of the following seven values:

\[ F \ 2700, \ P \ 2700, \ F \ 3000, \ F \ 3500, \ F \ 4000, \ F \ 5000 \text{ or } F \ 6500 \]

For reference purposes, the standardized chromaticity co-ordinates and CCT values corresponding to these colours are given in IS 2418 (Part 2).

The chromaticity of a LED lamp is measured both initially and maintained after an operation time of 25 percent of rated lamp life (with a maximum duration of 6 000 h). The measured actual chromaticity values both initial and maintained are expressed as fitting within one of four categories (see Table 3), corresponding to particular MacAdam ellipse tolerances around the rated colour as indicated by the manufacturer or responsible vendor.

For colour marking requirements (see Table 1).

To comply with this standard, the measured initial and maintained chromaticity values of each LED lamp in the sample shall be within the rated colour category of Table 2 and Table 3. A tolerance category shall be assigned according to the MacAdam ellipse size that includes (circumscribes) the chromaticity co-ordinates of all LED lamps in the tested sample.

The behaviour of the chromaticity co-ordinates is expressed by marking the two measurement results of both the initial chromaticity co-ordinates and the maintained chromaticity co-ordinates.

<table>
<thead>
<tr>
<th>SI No.</th>
<th>Colour Indication</th>
<th>CCT</th>
<th>( x )</th>
<th>( y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>i)</td>
<td>F 6500</td>
<td>6 400</td>
<td>0.313</td>
<td>0.337</td>
</tr>
<tr>
<td>ii)</td>
<td>F 5700</td>
<td>5 700</td>
<td>0.329</td>
<td>0.342</td>
</tr>
<tr>
<td>iii)</td>
<td>F 5000</td>
<td>5 000</td>
<td>0.346</td>
<td>0.359</td>
</tr>
<tr>
<td>iv)</td>
<td>F 4000</td>
<td>4 040</td>
<td>0.380</td>
<td>0.380</td>
</tr>
<tr>
<td>v)</td>
<td>F 3500</td>
<td>3 450</td>
<td>0.409</td>
<td>0.394</td>
</tr>
<tr>
<td>vi)</td>
<td>F 3000</td>
<td>2 940</td>
<td>0.440</td>
<td>0.403</td>
</tr>
<tr>
<td>vii)</td>
<td>F 2700</td>
<td>2 720</td>
<td>0.463</td>
<td>0.420</td>
</tr>
<tr>
<td>viii)</td>
<td>P 2700</td>
<td>2 700</td>
<td>0.458</td>
<td>0.410</td>
</tr>
</tbody>
</table>

NOTE — The letters in the ‘Colour’ designation stand for:

a) \( F \) = values from IS 2418 (Part 2) and IS 15687 (Part 1); and
b) \( P \) = value close to the Planckian curve.

Example: CAT C/B, meaning initial shift within a 5 step ellipse and maintained shift within a 7 step ellipse.

NOTE — This standard applies mainly to retrofit LED lamps for which it is important that the chromaticity corresponds as much as possible to the lamps to be replaced. Tolerances are based on the CIE 1931 MacAdam ellipses as normally applied for (compact) fluorescent lamps and other discharge lamps.
Table 3 Tolerance (Categories) on Nominal Chromaticity Co-ordinate Values
(Clause 12.1)

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Enclosing MacAdam Ellipse Size</th>
<th>Colour Variation Category</th>
<th>Initial Maintained</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>i)</td>
<td>3 step spread centered on the rated colour target</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>ii)</td>
<td>5 step</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>iii)</td>
<td>7 step</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>iv)</td>
<td>&gt;7 step</td>
<td>A</td>
<td>A</td>
</tr>
</tbody>
</table>

12.2 CRI

The initial colour rendering index (CRI) of an LED lamp is measured as is the value after a total operation time of 25 percent of rated lamp life (with a maximum duration of 6 000 h). To comply with this standard, all measured initial CRI values from the sample LED lamps shall be greater than or equal to the rated CRI value (see Table 1) less 3 points and all measured maintained CRI values (at 25 percent of rated lamp life with a maximum duration of 6 000 h) shall be greater than or equal to the rated CRI value less 5 points (see Table 1).

For method of measurement refer to IS 16106.

13 LAMP LIFE

Life of a self-ballasted LED lamp as defined in 3.5 is the combined result of the lumen maintenance performance (see 3.1) and the life of the built-in control gear and the LED(s) itself (see 13.2). An indication for the reliability and life of the control gear is attained by an endurance test (see 13.2). Both elements are tested.

Reference is made to the definitions of 3.5 and 3.6, describing the indicated percentage of tested lamps of a total batch (F, 50 or F, 10) that may fail the requirements of the tests under 13.1 and 13.2.

For marking of rated life (see Table 1),

13.1 Lumen Maintenance

This standard has opted for lumen maintenance categories that cover the initial decrease in lumen until 25 percent of rated lamp life has elapsed with a maximum duration of 6 000 h, see Fig. 1. Based on the life definition (L, 70) there are three categories each covering an additional 10 percent of lumen maintenance compared to the initial lumen output at 0 h as given in Table 4.

**NOTES**

1. As the typical life of a self-ballasted LED lamp is (very) long, it is within the scope of this standard regarded unpractical and time consuming to measure the actual lumen reduction over life (L, 70). For that reason this standard relies on approximation methods to determine the expected life (L, 70) of any self-ballasted LED lamp.

The actual LED behaviour with regard to lumen maintenance may differ considerably per type and per manufacturer. It is not possible to express the lumen maintenance of all LED’s in simple mathematical relations. A fast initial decrease in lumen output does not automatically imply that a particular LED will not make its rated life.

2. Compliance of lumen maintenance after 25 percent of life time or 6 000 h implies that the lamps would have a nominal life of 25 000 h.

The initial luminous flux shall be measured, which measurement is repeated at 25 percent of rated lamp life (with a maximum duration of 6 000 h). The initial luminous flux value is normalized to 100 percent; it is used as the first data point for determining lamp life. The measured luminous flux value at 25 percent of rated lamp life (with a maximum duration of 6 000 h) shall be expressed as a percentage of the initial value.

It is recommended to measure the lumen maintenance at 1 000 h intervals (expressed as a percentage of the initial value) for a total equal to 25 percent of rated lamp life (with a maximum duration of 6 000 h).

**NOTE** — This will give additional insight as to the reliability of the measured values.

For marking of the lumen maintenance (L, 70) and lumen maintenance categories (see Table 1).

A self-ballasted LED lamp is considered having passed the test when the following criteria have been met (see Fig. 1):

a) The measured flux value at 25 percent of rated lamp life (with a maximum duration of 6 000 h) shall never be less than the maximum lumen maintenance related to the rated life (L, 70) as defined and provided by the manufacturer or responsible vendor.

b) The measured lumen maintenance shall correspond with the lumen maintenance category as defined and provided by the manufacturer or responsible vendor: Cat 1 to Cat 3 for L, 70.

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Luminous Flux Decrease in Percent of 0 h Value</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>i)</td>
<td>≤10 percent</td>
<td>1</td>
</tr>
<tr>
<td>ii)</td>
<td>≤20 percent</td>
<td>2</td>
</tr>
<tr>
<td>iii)</td>
<td>≤30 percent</td>
<td>3</td>
</tr>
</tbody>
</table>

13.2 Endurance Test for Built-in Electronic Ballast

Since a self-ballasted LED lamp is a unit, which cannot
be dismantled without being permanently damaged, the built-in control gear has to be tested as part of a LED lamp.

13.2.1 LED lamps shall be subjected to a temperature cycling test and a supply voltage-switching test as follows:

a) **Temperature cycling test** — The non-energized LED lamp shall be stored at temperature not higher than –10°C for 1 hour minimum. The lamp is then immediately (within 1 minute maximum) moved into a cabinet having a temperature of at least 50°C and stored for one hour minimum. Five (5) cycles of this shall be carried out without time interruption. The samples in this test shall not be used for any other test found within the standard. The test is passed if there are zero LED failures within the lamp and no catastrophic faults of the lamp performance such as cracks, disassembly, drop in lumens below L₇₀.

NOTE — The aim of the test is to check for example the soldering quality of the production.

b) **Supply voltage switching test** — The ON 30 s/OFF 30 s cycling shall be repeated for a number of cycles equal to half the rated lamp life in h (Example: 10 k cycles if rated life is 20 kh).

At the end of these tests (a) and (b) the LED lamp shall operate and remain alight for 15 min. and show no physical effects of the temperature cycling such as cracks or delaminating of the label. All LED lamps in the test sample must pass these post treatment criteria.

13.2.2 The LED lamp shall then be operated without switching at test voltage and at an ambient temperature of 45°C until a test period equal to 25 percent or the rated lamp life (with a maximum of 6 000 h) has passed.

At the end of this time, and after cooling down to room temperature, the lamp shall remain alight for at least 15 min.

NOTE — The aim of the test is to check for example the capacitor design.

14 DIMMING

Requirements are under consideration.

15 HARMONICS AND POWER FACTOR

15.1 The harmonics of the input current when measured in accordance with IS 14700 (Part 3/Sec 2) shall be as given in 16.1.1 and 16.1.2.

15.1.1 For LED lamp, the harmonic current shall not exceed the limits given in Table 5.
15.2 Power factor for LED lamp shall be minimum 0.9.

Table 5 Limits of Harmonic Current
(Clause 15.1.1)

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Harmonic Order</th>
<th>Maximum Permissible Harmonic Current Expressed as a Percentage of the Input of the Fundamental Frequency Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>i) 2</td>
<td>2</td>
<td>λ₁</td>
</tr>
<tr>
<td>ii) 3</td>
<td>30 λ₁</td>
<td></td>
</tr>
<tr>
<td>iii) 5</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>iv) 7</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>v) 9</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>vi) 11 ≤ n ≤ 39</td>
<td>3</td>
<td>(odd harmonic only)</td>
</tr>
</tbody>
</table>

λ₁ is the circuit power factor.

16 TEST FOR EMISSION (RADIATED AND CONDUCTED) OF RADIO FREQUENCY DISTURBANCES

16.1 The emission (radiated and conducted) of radio frequency disturbances when measured in accordance with IS 6873 (Part 5) shall be as given in 16.1.1 and 16.1.2.

16.1.1 LED lamp shall comply with the terminal voltage limits given in Table 6.

Table 6 Limits of Frequency Range Against Emission

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Frequency Range</th>
<th>Limits of Frequency Range dB(µV)¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3) (4) (5)</td>
</tr>
<tr>
<td>i) 9 kHz-70 kHz</td>
<td>88 81 75</td>
<td></td>
</tr>
<tr>
<td>ii) 70 kHz-150 kHz</td>
<td>88-58 81-51 75-45</td>
<td></td>
</tr>
<tr>
<td>iii) 150 kHz-2.2 MHz</td>
<td>58-26 51-22 45-16</td>
<td></td>
</tr>
<tr>
<td>iv) 2.2 MHz-3.0 MHz</td>
<td>58 51 45</td>
<td></td>
</tr>
<tr>
<td>v) 3.0 MHz-30.0 MHz</td>
<td>22 15-16 9-12</td>
<td></td>
</tr>
</tbody>
</table>

¹ At the transmission frequency, the lower limit applies.
² Decreasing linearly with the logarithm of the frequency.
³ Increasing linearly with the logarithm of the frequency.

17 SELECTION OF LAMPS FOR TESTS (SAMPLING)

17.1 Inspection Test Quantities (ITQ)

The sampling criteria, condition of compliance and tests to be carried out for ITQ shall be as given in 16 and 17 of IS 16102 (Part 1).

NOTE — Method of selection of lamps for type testing are under consideration.

17.2 Rating Test Quantity (RTQ)

Rating test quantity consisting of 15 LED lamps shall be selected at random from the lamps which have passed the inspection test. The RTQ shall comprises of the tests given in 18.2 and 18.3.

17.3 Life Test Quantity (LTQ)

Life test quantity consisting of 10 LED lamps shall be selected at random from the lamps which have passed the rating tests. The LTQ shall comprise of the tests for life and lumen maintenance.

17.4 Accidentally Broken and/or in Corrected Operated Lamps

Lamps, which are accidentally broken and or have been operated in conjunction with incorrect controlgear before the life test is completed, shall, when necessary, be replaced to ensure that the required number of test lamps completes the test. Any such broken or incorrectly operated lamps shall be neglected in the evaluation of life test results.

NOTE — In order to avoid unnecessary delay, it is recommended that spare lamps be available through the test.
17.5 Test for Harmonics
The number of sample for this test shall be one.

17.6 Test for Emission (Radiated and Conducted) of Radio Frequency Disturbances
The number of sample for this test shall be one.

18 CONDITIONS OF COMPLIANCE

18.1 General Conditions
A batch shall be considered as confirming to this standard, if the requirements contained in this standard are fulfilled. If the batch fails to satisfy the requirements of any of these requirements, it shall be deemed not to comply with this standard.

18.2 Acceptance Test
A batch shall be considered to comply with the requirements of acceptance test if the number of LED lamps failing does not exceed the qualifying limits given below:

<table>
<thead>
<tr>
<th>Test Parameters</th>
<th>Qualifying Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>For wattage of individual lamps (see 8)</td>
<td>4</td>
</tr>
<tr>
<td>For initial luminous flux of individual lamps (see 9)</td>
<td>4</td>
</tr>
<tr>
<td>Colour (see 12)</td>
<td>2</td>
</tr>
<tr>
<td>For all the requirements taken together</td>
<td>5</td>
</tr>
</tbody>
</table>

18.3 Marking, Dimension, Centre Beam Intensity and Beam Angle

Compliance shall be considered to be achieved if all the lamps of the RTQ (see 17.2) meet the requirements of 5, 6, 10 and 11.

In the event of one or more failures the remaining LED lamps of RTQ shall be tested, from which not more than one shall fail.

18.4 Life and Lumen Maintenance

A batch shall be considered to comply with the requirements of life if the total number of LED lamps having life shorter than 25 percent of rated life or 6 000 h together with those failing to meet the requirements of lumen maintenance, does not exceed two.

18.5 Harmonics

Compliance shall be considered to be achieved if the sample selected meets the requirements of this standard.

18.6 Emission (Radiated and Conducted) of Radio Frequency Disturbances

Compliance shall be considered to be achieved if the sample selected meets the requirements of this standard.

19 TESTS

19.1 Classification of Tests

19.1.1 Type Tests

The following shall constitute the type tests to be carried out on selected sample of self-ballasted LED lamps, sample being drawn preferably from regular production lot:

a) Marking (see 5),
b) Dimension (see 6),
c) Wattage (see 8),
d) Luminous flux (see 9),
e) Centre beam intensity (see 10),
f) Beam angle (see 11),
g) Colour chromaticity and colour rendering index (CRI) (see 12),
h) Life (see 13),
j) Harmonics (see 15), and
k) Emission (radiated and conducted) of radio frequency disturbances (see 16).

19.2 Acceptance Test

The following shall constitute as acceptance tests:

a) Marking (see 5),
b) Dimension (see 6),
c) Wattage (see 8),
d) Luminous flux (see 9),
e) Centre beam intensity (see 10),
f) Beam angle (see 11), and
g) Colour chromaticity and colour rendering index (CRI) (see 12).
ANNEX A
(Clauses 4 and 7)

METHOD OF MEASURING LAMP CHARACTERISTICS

A-1 GENERAL

All tests shall be made in a draught-free room at an ambient temperature of 27 ± 1°C and a relative humidity of 65 percent maximum.

The test voltage shall be stable within ±0.5 percent, during stabilization periods, this tolerance being ±0.2 percent at the moment of measurements. For luminous flux maintenance testing the tolerance is 2 percent. The total harmonic content of the supply voltage shall not exceed 3 percent. The harmonic content is defined as the R.M.S. summation of the individual harmonic components using the fundamental as 100 percent.

All tests shall be carried out at rated frequency. Unless otherwise specified for a specific purpose by the manufacturer or responsible vendor, lamps shall be operated in free air in a vertical base-up position for all tests including lumen maintenance tests.

A-2 ELECTRICAL CHARACTERISTICS

A-2.1 Test Voltage

The test voltage shall be the rated voltage (see A-1). In case of a voltage range, measurements shall be carried out at the voltage which produces the highest temperature.

A-2.2 Ageing

Lamps normally do not require any ageing prior to testing. However, the manufacturer may define an ageing period upto 500 h.

A-2.3 Stabilization Time

Measurements shall start immediately after stabilisation. Stable operation has been reached when the temperature of the LED lamp is not increasing more than 1 K/h.

A-3 PHOTOMETRIC CHARACTERISTICS

A-3.1 Test Voltage

The test voltage shall be the rated voltage (see A-1). In case of a voltage range, measurements shall be carried out at the voltage which produces the highest temperature.

A-3.2 Establishing Lumen Values

The initial luminous flux shall be measured after thermal stabilisation of the LED lamp, for conditions (see A-2.3). Reference is made to document IS 16106.

NOTE — Method of measuring the luminous flux of LED lamps is under discussion. Annex B has been reserved for a description of an improved method.

ANNEX B
(Clauses 4 and 9)

METHOD OF MEASURING LUMINOUS FLUX FOR LED LAMPS

The contents of this Annex are under consideration.

ANNEX C
(Table 1)

HOW TO COMPOSE AND UNDERSTAND A PHOTOMETRIC CODE

Example of a lamp photometric code likes 830/AA1, meaning:
IS 16102 (Part 2) : 2012

| 8 | 3 | 0 | / | A | A | 1 |
---|---|---|---|---|---|---|

- CRI between 77 and 86
- nominal CCT of 3 000 K
- initial spread of chromaticity coordinates within a 3 step MacAdam ellipse
- maintained spread of chromaticity co-ordinates within a 3 step MacAdam ellipse
- drop in lumen output of max 10 percent at 25 percent of rated lamp life (with a maximum duration of 6 000 h).
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This Indian Standard has been developed from Doc No.: ETD 23 (6299).

Amendments Issued Since Publication

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