FOREWORD

(Formal clause will be added later)

This standard (part 2) specifies the performance requirements for self ballasted lamps for general lighting services for supply voltages up to and including 250 V ac.

The general and safety requirements have been covered in part 1 of this standard (under preparation)

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.

The present standard takes up the supply voltage range from above 50 V up to and including 250 V ac. A safety standard for LED lamps with voltages less than or equal to 50 V may follow in due course.

Future work will also consequently comprise performance standards for all kind of LED lamps, including minimum photometric requirements for type testing.

Due to the urgent need of establishing this standard, it will be a stand alone standard for the time being, not excluding a future relocation as a sub-part of IS 15111(Part 2), self-ballasted lamps.

This standard is based on IEC document 34A/1343/CD (IEC 62612) 'Self ballasted LED-lamps for general lighting services by voltage above 50 V-Performance requirements (under preparation) issued by the International Electrotechnical Commission (IEC) with following modifications:

a) Schedule of type test and acceptance test has been incorporated;

- b) Ambient test condition changed to 27°C;
- c) Selection of samples incorporated;
- d) Conditions of compliances incorporated;
- e) E 26 caps not included.

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, 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.

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SELF-BALLASTED LED-LAMPS FOR GENERAL LIGHTING SERVICES

Part 2Performance requirements

1 SCOPE

- **1.1** This standard (part 2)specifies the performance requirements for self-ballasted LED lamps with a supply voltage up to 250 V, 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 voltage of up to 250V ac or dc;
 - c) a lamp cap according to IS xxxx (IEC 62560) (under preparation) (safety standard for self-ballasted LED lamps)

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 xxxx (IEC 62560) (under preparation)(safety standard for self-ballasted LED lamps)

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

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).

NOTES

1. 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 following Indian standards are necessary adjunct to this standard.

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IS No.	Title
1885(Part 16/Sec 1):1968	Electrotechnical vocabulary Part 16 Lighting, Section 1 General aspects
2418(Part 1): 1977	Tubular fluorescent lamps for general lighting services Part 1 Requirements and tests
6873 (Part 5): 1999 (revised version under print)	Limits and methods of measurement of radio disturbance characteristics : Part 5 Electrical lighting and similar equipment
9206:1979	Dimensions of caps for tungsten filament general service electric lamps
10276 (Part 1):1982	Edison screw lampholders Part 1 Requirements and tests
10276 (Part 2):1982	Edison screw lampholders Part 2 Standard data sheets for lamp holders and gauges
10322 (Part 1) : 2010 (under print)	Luminaire: Part 1 General requirement and tests
14700 (Part 3/Sec 2) :1999 (under revision)	Electromagnetic compatibility Part 3 Limits Sec 2 Limits for harmonic current emissions
Doc:ET 23 (5842) (under preparation)	Single capped fluorescent lamps : Part 2 Performance requirements
IS xxxxx/IEC 62031(Under preparation)	LED modules for general lighting Part 1 Safety requirements
IS xxxxx/IEC 62504 (under preparation)	General lighting – LED and LED modules – Terms and definitions
IS xxxxx/IEC 62560(under preparation)	Self-ballasted LED lamps Part 1 Safety Requirements
CIE 13.3:1995*	Method of measuring and specifying colour rendering of light sources(under consideration)
IES LM-79-08*	Method for the Electrical and Photometric Measurements of Solid-State Lighting Products (under consideration)

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CIE 127:2007*	Measurement of LEDs
IEC TR 61341*	Method of measurement of centre beam intensity and beam angle(s) of reflector lamps
IES LM-80-08*	IES Approved Method: Measuring Lumen Maintenance of LED Light Sources

BISDG NOTE- * Standards are required to be developed after decision is taken by ET 23.

3 TERMINOLOGY

Following definitions in addition to those given in IS xxxxx/IEC 62504 and IS 1885 (Part 16/Sec 1 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_x)

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 4 and **3.7**).

NOTES:

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- 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 (see 3.7).
- 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_{70} , F_{50} . For professional applications, the combined value L_{70} , F_{10} 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 Clause 7.
- 2. Notes 1, 2 and 4 of 3.5 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 the marking clause (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 marking clause (Table 1).

3.9 Stabilization Time

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

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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 initial readings and colour.

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 in IS xxxx/IEC 62560 (safety standard for self-ballasted LED lamps; under preparation)

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

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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 xxxxx/IEC 62560) by the manufacturer or responsible vendor, and placed as specified in **5.2**.

5.2 Places of Marking

Table 1Places where Marking is required(Clause 5.2, 12.1, 12.2, 13 and 13.1)

	(A) Product and packaging1)	(B) Packaging	(B) Product datasheets or leaflets or website
a) Rated luminous flux (lm), centre beam intensity (lm in a cone of 90°) and beam angle (NOTE 2)	-	X	X
b) Lamp photometric code (see	Х	-	Х
c) Rated life and the related lumen maintenance (L_x)	-	X	X
d) Failure fraction (Fx), corresponding to the rated life	-	Х	Х
e) Lumen maintenance category (Cat 1 to 3, see Clause 13.1, Table 4)	-	X	Х
f) Rated colour (F 2700 to F 6500, see Table 2 in clause 12.1) including initial and maintained colour variation category (A to D, see Table 3)	х	Х	Х
g) Rated Colour Rendering Index	-	Х	X
h) Ageing time (h), if different to 0 h	-	-	Х

NOTES:

1. These requirements are minimal. Additional regional regulatory marking requirements may exist and overrule.

2. For directional lamps, centre beam intensity and beam angle are measured according to IEC TR 61341. If space on the lamp is not large enough, marking of the rated luminous output on the packaging is sufficient.

3. x = required, - = not required

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5.3 BIS Certification Marking

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

5.3.1 The use of Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made there under. The details of conditions under which the licence for the use of 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 6000 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 6000 h test is conducted in parallel and in case of doubt the result is drawn at the end of the 6000 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 10 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,

$$x + \left(1,96 \cdot \frac{s}{\sqrt{n}}\right),$$

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.

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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 95 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,

$$x - \left(1,96 \cdot \frac{s}{\sqrt{n}}\right),$$

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

For marking of the rated luminous flux see Table 1.

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,

$$x - \left(1,96 \cdot \frac{s}{\sqrt{n}}\right),$$

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.

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,

$$x \pm \left(1,96 \cdot \frac{s}{\sqrt{n}}\right),$$

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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:

F2700, P2700, F3000, F3500, F4000, F5000 or F6500

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

Table 2
Correlated Colour Temperatures and Chromaticity Co-ordinates
(<i>Clause</i> 12.1)

Colour	ССТ	X	у
F 6500	6400	0.313	0.337
F 5000	5000	0.346	0.359
F 4000	4040	0.380	0.380
F 3500	3450	0.409	0.394
F 3000	2940	0.440	0.403
F 2700	2720	0.463	0.420
P 2700	2700	0.458	0.410

NOTE: 1

The letters in the "Colour" designation stand for:

F = Values from IS 2418 (Part 2) and IS xxxxx (Doc: ET 23 (5842) (under preparation)

P = Value close to the Planckian curve

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.

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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 (See 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.

Table 3	
Tolerance (Categories) on Nominal Chromaticity	Co-Ordinate Values
(<i>Clause</i> 12.1)	

Enclosing MacAdam ellipse size	Colour Variation Category	
	initial	maintained
3-step spread centered on the rated colour target	D	D
5-step	С	С
7-step	В	В
>7-step	А	А

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.

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

NOTE-2

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.

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 6000 h) shall be greater than or equal to the rated CRI value less 5 points. (*see* Table 1).

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Reference is made to CIE 13.3 Method of measuring and specifying colour rendering of light sources.

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 6000 h, see Figure 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 (see Table 4).

NOTES:

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 standards relies on approximation methods to determine the expected life (L_{70}) of any self-ballasted LED lamp.

The actual LED behavior 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.

Table 4
Categories of Lumen Maintenance after 25 Percent of Life Time or 6000h
(<i>Clause</i> 13.1)

Luminous flux decrease in % of 0 h value	Code
≤10%	1
≤20%	2
≤30%	3

The initial luminous flux shall be measured, which measurement is repeated at 25 percent of rated lamp life (with a maximum duration of 6000 h). The initial luminous flux value is normalized to 100 percent; it is used as the first data point for determining lamp life. The

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measured luminous flux value at 25 percent of rated lamp life (with a maximum duration of 6000 h) shall be expressed as a percentage of the initial value.

It is recommended to measure the lumen maintenance at 1000 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 6000 h).

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

For marking of the lumen maintenance (L_x) 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:

- 1. The measured flux value at 25% of rated lamp life (with a maximum duration of 6000 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.
- 2. 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} .





13.2 Endurance Test for Built-in Electronic Ballast

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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. Fifty (50) 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 L_{70} .

NOTE- The aim of the test is to check e.g. 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 minutes 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 $+45^{\circ}$ C until a test period equal to 25 percent or the rated lamp life (with a maximum of 6000 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 e.g. the capacitor design.

14 **DIMMING**

Requirements are under consideration.

15 HARMONICS

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 having an active input power greater than 25 W, the harmonic current shall not exceed the limits given in Table 5 A.

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Table 5A
Limits of Harmonic Current
(<i>Clause</i> 15.1.1)

Harmonic Order	Maximum Permissible Harmonic Current Expressed as a percentage of the input of the fundamental
	Frequency
n	Percent
(1)	(2)
2	2
3	$30 \lambda^{1)}$
5	10
7	5
9	7
$11 \le n \le 39$	3
(odd harmonic only) $^{1)}\lambda$ is the circuit power factor	

15.1.2 For LED lamp having an active input power smaller than or equal to 25 W, the harmonic current shall comply with one of the following two sets of requirements.

The harmonic current shall not exceed the power related limits of column 2 of Table 5 B, or,

Third harmonic current, expressed as a percentage of the fundamental current, shall not exceed 86 percent and the fifth shall not exceed 61 percent. Moreover, the waveform of the input current shall be such that it begins to flow before or at 60 °, has its last peak (if there are several peaks per half period) before or at 65 ° and does not stop flowing before 90 °, where the zero crossing of the fundamental supply voltage is assumed to be at 0 °.

Table 5 B			
Limits of Harmonic Current			
(<i>Clause</i> 15.1.2)			

Harmonic Order	Maximum Permissible Harmonic Current per watt mA/W	Maximum Permissible Harmonic Current per watt A
n		
(1)	(2)	(3)
3	2.4	2.30
5	1.9	1.14
7	1.0	0.77
9	0.5	0.40
11	0.35	0.33
$13 \le n \le 39$	3.85	0.15
(odd harmonic only)	n	n

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

The emission (radiated and conducted) of radio frequency disturbances when measured in 16.1 accordance with 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 A.

Frequency range	Lir dB(1	nits $(\mathbf{V})^{(1)}$	
	quasi peak	Average	
(1)	(2)	(3)	
9 kHz to 50 kHz $^{2)}$	110	-	
50 kHz to 150 kHz $^{2)}$	90 to 80 ³⁾	-	
150 kHz to 0.5 MHz	66 to 56 $^{3)}$	56 to 46 $^{3)}$	
0.5 MHz to 2.51 MHz	56	46	
2.51 MHz to 3.0 MHz	73	63	
3.0 MHz to 5.0 MHz	56	46	
5.0 MHz to 30.0 MHz	60	50	

Limits of Frequency Range against Emission (*Clause* 16.1.1)

Table 6 A

 $^{\mbox{\tiny I})}$ At the transmission frequency, the lower limit applies.

²⁾ The limit values in the frequency range 9 kHz to 150 kHz are considered to be provisional which may be modified after some years of experience. ³⁾The limit decreases linearly with the logarithm of the frequency range of 9 kHz to 50 kHz and 150 kHz to 0.5 MHz.

16.1.2 Where the light source is operated at a frequency exceeding 100 Hz, the lamp shall comply with the lamp shall comply with the field strength limits given in Table 6 B.

т. Ц. С. Т.

Limits of Loop Diameter against Transient Frequency Range (<i>Clause</i> 16.1.2)					
Frequency range	Limits of loop diameter dB(µA) ¹⁾				
	2m	3m	4m		
(1)	(2)	(3)	(4)		
kHz to 70 kHz	88	81	75		
0 kHz to 150 kHz	88 to 58 ²⁾	81 to 51 $^{2)}$	75 to 45 $^{2)}$		
50 kHz to 2.2 MHz	58 to 26 $^{2)}$	51 to 22 $^{2)}$	45 to 16 $^{2)}$		
.2 MHz to 3.0 MHz	58	51	45		
.0 MHz to 30.0 MHz	22	15 to 16 $^{3)}$	9 to 12^{3}		
⁹ At the transmission frequence	cy, the lower limit applies.				
decreasing linearly with the	logarithm of the frequency.				
increasing linearly with the	logarithm of the frequency				

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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 part 1 of this standard.

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

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.

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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:

Test Parameters	Qualifying Limits	
For wattage of individual lamps (See 8)	4	
For initial luminous flux of individual lamps (see 9)	4	
Colour (See 12)	2	
For all the requirements taken together	5	

18.3 Marking, Dimension, Centre Beam Intensity and Beam Angle

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

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 hours of rated life or 6000 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),

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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),
- g) Colour Chromaticity and Colour Rendering Index (CRI) (see 12),

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ANNEX A Method of Measuring Lamp Characteristics (Clause 7)

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 baseup 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 (for tolerance *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 of up to 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 5 K per hour.

A.3 Photometric Characteristics

A.3.1 Test Voltage

The test voltage shall be the rated voltage (for tolerance *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 CIE 127 and IES LM-79-08.

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

METHOD OF MEASURING LUMINOUS FLUX FOR LED LAMPS

(Clause 7 and 8)

The contents of this Annex are under consideration.

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ANNEX C How to compose and understand a photometric code (Clause 5.2)

Example of a lamp photometric code likes 830/AA1, meaning:



ANNEX D Binning procedure of luminous flux

Under consideration

ANNEX E Binning procedure of white colour LEDs

Under consideration

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