

# इंटरनेट

# मानक

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“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS 15111-2 (2002): Self Ballasted Lamps for General Lighting Services, Part 2: Performance Requirements [ETD 23: Electric Lamps and their Auxiliaries]



“ज्ञान से एक नये भारत का निर्माण”

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“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”



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IS 15111 ( Part 2 ) : 2002

भारतीय मानक  
सामान्य प्रकाश व्यवस्थाओं के लिए स्वतः बालास्टकृत लैम्प  
भाग 2 कार्यकारिता अपेक्षाएँ

*Indian Standard*  
SELF BALLASTED LAMPS FOR GENERAL  
LIGHTING SERVICES  
PART 2 PERFORMANCE REQUIREMENTS

ICS 29.140.30

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

*February 2002*

**Price Group 5**

## 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.

The lamps covered under this standard are self ballasted lamps. Such lamps incorporate permanently enclosed elements that are necessary for starting and for stable operation and which does not include any replaceable or interchangeable parts.

These lamps are considered as energy efficient lamps and are commonly known as compact fluorescent lamps.

The need of preparing this standard has been realized only after ensuring the manufacturing potential and demand in the country.

There are other types of compact fluorescent lamps, which are the discharge lamp of the low-pressure mercury type having single cap for operations on external circuits with either an internal or external means of starting. The requirements of such lamps will be covered in a separate standard.

This standard has been dealt within two parts one exclusively on safety requirements and the other on performance requirements.

This standard is based on IEC 60969 ( 1988 ) 'Self ballasted lamps for general lighting services, performance requirements' issued by the International Electrotechnical Commission ( IEC ) with following modifications:

- a) Schedule of type test and acceptance test have been incorporated;
- b) Ambient test condition changed to 27°C;
- c) Selection of samples incorporated;
- d) Conditions of compliances incorporated;
- e) Lamps of rating up to 26 W are only covered; and
- f) 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.

**AMENDMENT NO. 1   APRIL 2003**  
**TO**  
**IS 15111 ( Part 2 ) : 2002   SELF BALLASTED LAMPS**  
**FOR GENERAL LIGHTING SERVICES**  
**PART 2   PERFORMANCE REQUIREMENTS**

( *Page 4, clause 17.1.3* ) — Insert the following at the end:

**18 MARKING**

**18.1** The lamps shall be clearly and durably marked as given in 6.1 to 6.3 of IS 15111( Part 2 ).

**18.2 BIS Certification Marking**

**18.2.1** The lamps may also be marked with the Standard Mark.

**18.2.2** The use of 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 use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.'

( ET 2

**AMENDMENT NO. 2 AUGUST 2003**  
**TO**  
**IS 15111 ( PART 2 ) : 2002 SELF BALLASTED LAMPS**  
**FOR GENERAL LIGHTING SERVICES**  
**PART 2 PERFORMANCE REQUIREMENTS**

( *Page 3, clause 12, line 2* ) — Substitute '85 percent' for '90 percent'.

( *Page 4, Table 1, col 2, Heading* ) — Substitute 'Maximum' for 'Minimum'.

( *Page 4, clause, Table 1* ) — Insert the following note at the end:

'NOTE — The requirements are not applicable for lamps of rated wattage up to and including 25.'

( ET 23 )

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Reprography Unit, BIS, New Delhi, India

**AMENDMENT NO. 3 NOVEMBER 2003**  
**TO**  
**IS 15111 (PART 2) : 2002 SELF BALLASTED LAMPS**  
**FOR GENERAL LIGHTING SERVICES**  
**PART 2 PERFORMANCE REQUIREMENTS**

( *Page 4, clause 16* ) — Substitute the following for the existing clause:

**'16 POWER FACTOR**

The power factor of the combination of the ballast and the lamp shall be as declared by the manufacturer.

NOTE — The value of the power factor is under consideration.'

[ *Page 4, clause 18.1, line 2 ( see also Amendment No. 1 )* ] — Substitute 'IS 15111 ( Part 1 )' for 'IS 15111 ( Part 2 )'.

( ET 23 )

Reprography Unit, BIS, New Delhi, India



**AMENDMENT NO. 4   APRIL 2005**  
**TO**  
**IS 15111 (PART 2) : 2002   SELF BALLASTED**  
**LAMPS FOR GENERAL LIGHTING SERVICES**  
**PART 2 PERFORMANCE REQUIREMENTS**

( *Page 4, clause 15* ) — Substitute the following for the existing:

‘The minimum rated luminous flux of lamp corresponding to each wattage and the colour temperature shall be derived from the value of lamp efficacy as given in Table 2’

( *Page 4, Table 2, heading, Reference to clause 15.1* ) — Substitute ‘15’ for ‘15.1’.

[ *Page 4, clause 17.1.3 (j)* ] — Delete.

**AMENDMENT NO. 5 DECEMBER 2005**  
**TO**  
**IS 15111 ( PART 2 ) : 2002 SELF BALLASTED LAMPS**  
**FOR GENERAL LIGHTING SERVICES**  
**PART 2 PERFORMANCE REQUIREMENTS**

( *Page 1, clause 1.1, line 4* ) — Substitute 'bare lamps' *for* 'lamps'.

( *Page 3, clause 9, line 3* ) — Delete ' -10 percent'.

( ET 23 )

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Reprography Unit, BIS, New Delhi, India

**AMENDMENT NO. 6 SEPTEMBER 2003**  
**TO**  
**IS 15111 (PART 2) : 2002 SELF BALLASTED LAMPS**  
**FOR GENERAL LIGHTING SERVICES**  
**PART 2 PERFORMANCE REQUIREMENTS**

(Page 1, clause 2) — Insert the following at the end:

<i>'IS No.</i>	<i>Title</i>
14700 (Part 3/Sec 2) : 1999	Electromagnetic Compatibility (EMC) : Part 3 Limits, Section 2 Limits for Harmonic Current Emission (Equipment input Current $\leq 16$ A per phase)'

(Page 3, clause 4.5) — Insert the following at the end:

**'4.6 Test for Emission (Radiated and Conducted) of Radio Frequency Disturbances**

The number of samples for this test shall be one.'

(Page 3, clause 5.4, line 3) — Substitute 'requirements of '8, 11, 16 and 18 of this standard.' for 'requirements of '8, 10, 16 and 18 of this standard.'

(Page 3, clause 5.6) — Insert the following at the end:

**'5.7 Emission (Radiated and Conducted) of Radio Frequency Disturbances**

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

NOTE — For measurement of terminal voltage and transient frequency, see Annex C.'

(Page 4, clause 14) — Substitute the following for the existing matter:

**'14 HARMONICS**

14.1 The harmonics of the input current when measured in accordance with IS 14700 (Part 3/Sec 2) shall be as given in 14.1.1 and 14.1.2.

**Price Group 2**

Amend No. 6 to IS 15111 (Part 2) : 2002

14.1.1 For lamps having an active input power greater than 25 W, the harmonic currents shall not exceed the limits given in Table 1A.

Table 1A Limits of Harmonic Current

Harmonic Order	Maximum Permissible Harmonic Current Expressed as a Percentage of the Input of the Fundamental Frequency
<i>n</i>	Percent
(1)	(2)
2	2
3	30 $\lambda$ <sup>1)</sup>
5	10
7	7
9	5
11 ≤ <i>n</i> ≤ 39 (odd harmonic only)	3

<sup>1)</sup>  $\lambda$  is the circuit power factor.

14.1.2 For lamps 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 currents shall not exceed the power related limits of col 2 of Table 1B, or;
- The 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°.

Amend No. 6 to IS 15111 (Part 2) : 2002

Table 1B Limits of Harmonic Current

Harmonic Order $n$	Maximum Permissible Harmonic Current per Watt mA/W	Maximum Permissible Harmonic Current A
(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
$13 \leq n \leq 39$ (odd harmonics only)	$\frac{3.85}{n}$	$0.15 \frac{15}{n}$

[Page 4, clause 16 (see also Amendment No. 3)] — Substitute the following for the existing text:

‘The power factor of the combination of the ballast and the lamp shall be 0.5, *Min.*

NOTE — The value of the power factor shall be 0.85, *Min* with effect from 01-01-2009.’

[Page 4, clause 17.1.3(k)] — Insert the following at the end:

‘m) Emission (radiated and conducted) of radio frequency disturbances.’

(Page 5, Annex A, clause A-2, last line) — Substitute ‘value’ for ‘valve’.

**Amend No. 6 to IS 15111 (Part 2) : 2002**

(Page 7, Annex B) — Insert the following new Annex at the end:

**ANNEX C**  
(Clause 5.7)

**EMISSION (RADIATED AND CONDUCTED) OF  
RADIO FREQUENCY DISTURBANCES**

Self ballasted lamps shall comply with the terminal voltage limits given in Table C-1.

**Table C-1 Limits of Frequency Range Against Emission**

Frequency Range  (1)	Limits dB (μ V) <sup>1)</sup>	
	Quasi-peak (2)	Average (3)
9 kHz to 50 kHz <sup>2)</sup>	110	-
50 kHz to 150 kHz <sup>2)</sup>	90 to 80 <sup>3)</sup>	-
150 kHz to 0.5 MHz	66 to 56 <sup>3)</sup>	56 to 46 <sup>3)</sup>
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 MHz	60	50

<sup>1)</sup> At the transition frequency, the lower limit applies.

<sup>2)</sup> 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.

<sup>3)</sup> The limit decreases linearly with the logarithm of the frequency range 9 kHz to 150 kHz and 150 kHz to 0.5 MHz.

Where the light source is operated at a frequency exceeding 100 Hz, the lamp shall comply with the field strength limits given in Table C-2.

**Amend No. 6 to IS 15111 (Part 2) : 2002**

**Table C-2 Limits of Loop Diameter Against Transient Frequency Range**

Frequency Range		Limits for Loop Diameter dB ( $\mu$ A) <sup>1)</sup>		
MHz	2 m	3 m	4 m	
(1)	(2)	(3)	(4)	
9 kHz to 70 kHz	88	81	75	
70 kHz to 150 kHz	88 to 58 <sup>2)</sup>	81 to 51 <sup>2)</sup>	75 to 45 <sup>2)</sup>	
150 kHz to 2.2 MHz	58 to 26 <sup>2)</sup>	51 to 22 <sup>2)</sup>	45 to 16 <sup>2)</sup>	
2.2 MHz to 3.0 MHz	58	51	45	
3.0 MHz to 30 MHz	22	15 to 16 <sup>3)</sup>	9 to 12 <sup>3)</sup>	

<sup>1)</sup> At the transition frequency, the lower limit applies.

<sup>2)</sup> Decreasing linearity with the logarithm of the frequency.

<sup>3)</sup> Increasing linearity with the logarithm of the frequency.

(Pages 8, 9 and 10, Annex B) — Substitute the following graphs of Fig. 1, Fig. 2 and Fig. 3 for the existing:

Amend No. 6 to IS 15111 (Part 2) : 2002

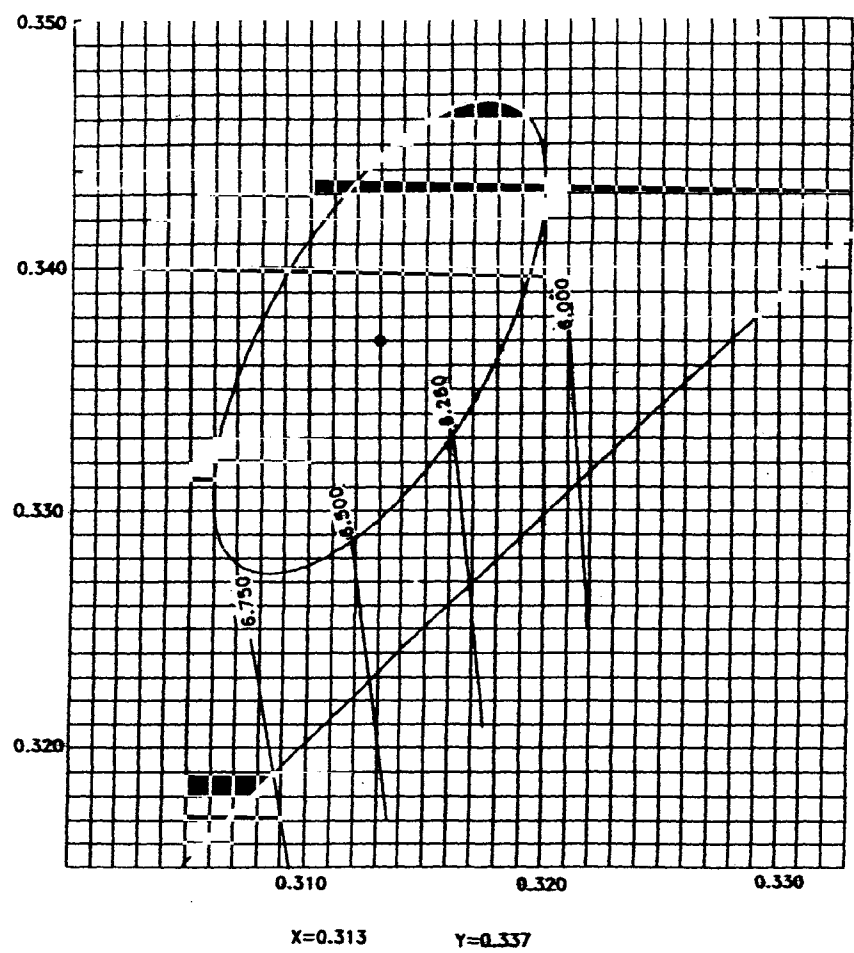


FIG. 1 TOLERANCE AREA FOR STANDARD 'COLOUR' 6500 k



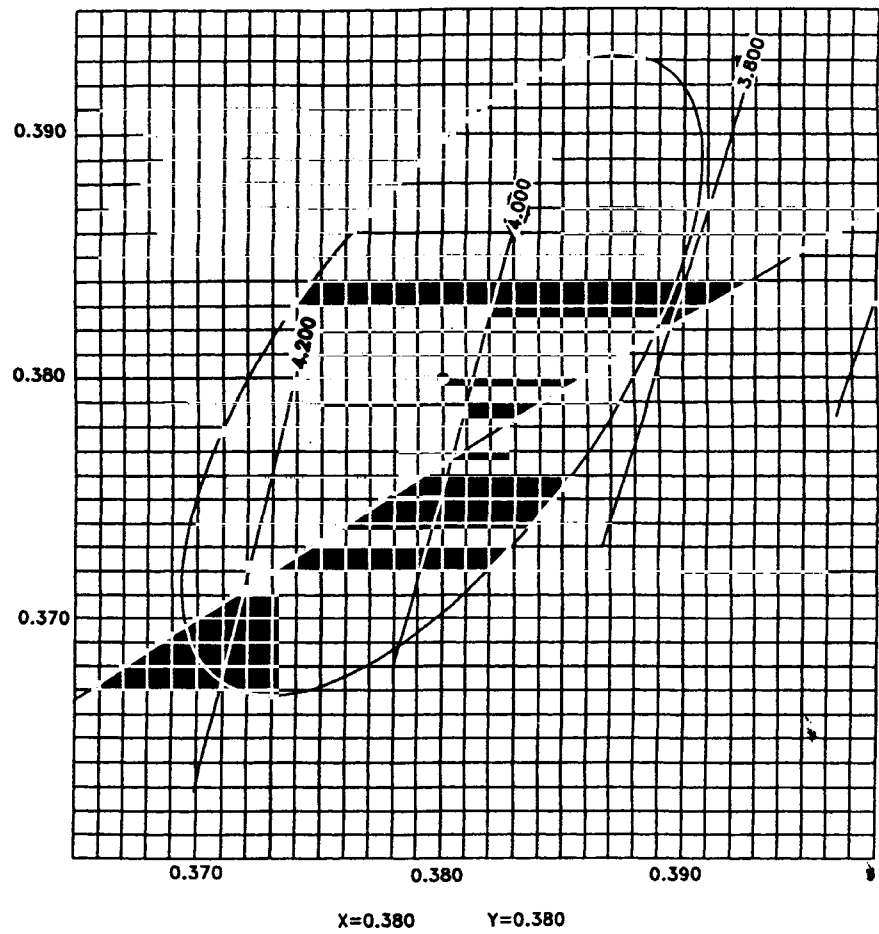


FIG. 2 TOLERANCE AREA FOR STANDARD 'COLOUR' 4000 k

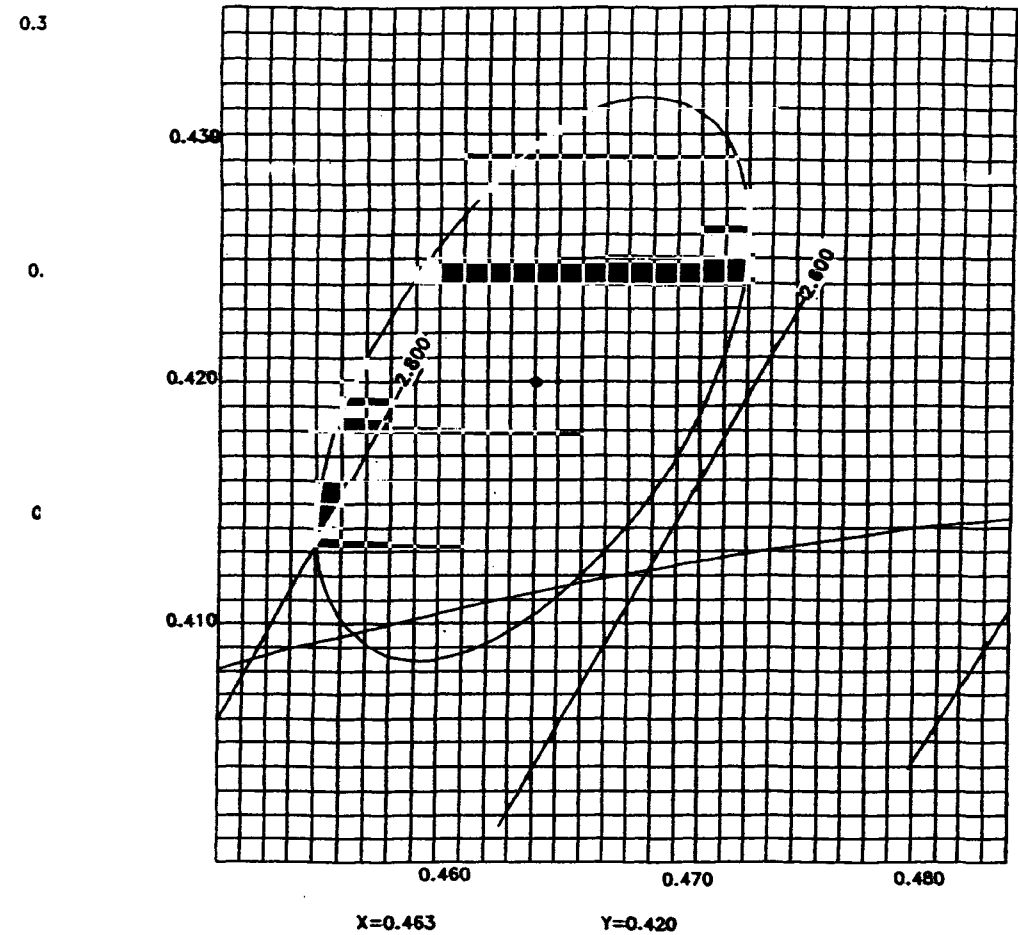


FIG. 3 TOLERANCE AREA FOR STANDARD 'COLOUR' 2700 k

(ET 23)

**AMENDMENT NO. 7 APRIL 2009**  
**TO**  
**IS 15111 (PART 2) : 2002 SELF BALLASTED LAMPS FOR**  
**GENERAL LIGHTING SERVICES**

[Page 3, clause **5.7**, NOTE (*see also Amendment No. 6*)] — Renumber the existing NOTE as NOTE 1 and insert the following Note at the end:

‘NOTE 2 — This test shall be applicable with effect from 1 October 2009.’

[Page 4, Table 1A (*see also Amendment No. 6*)] — Insert the following Note at the end of the Table:

‘NOTE — The limits of Harmonic Current shall be applicable with effect from 1 October 2009. Till such time, the limits of Harmonic Current as given up to Amendment No. 5 shall be applicable.’

[Page 4, Table 1B (*see also Amendment No. 6*)] — Insert the following Note at the end of the Table:

‘NOTE — The limits of Harmonic Current shall be applicable with effect from 1 October 2009.’

[Page 4, clause **16**, NOTE (*see also Amendment No. 6*)] — Substitute the following for the existing text:

‘NOTE — The value of the power factor shall be 0.85, *Min* with effect from 1 October 2009.’

*Indian Standard***SELF BALLASTED LAMPS FOR GENERAL  
LIGHTING SERVICES****PART 2 PERFORMANCE REQUIREMENTS****1 SCOPE**

1.1 This standard ( Part 2 ) specifies the performance requirements together with the test methods and conditions, required to show compliance of tubular fluorescent and other gas discharge lamps with integrated means for controlling starting and stable operation ( self ballasted lamps ), intended for domestic and similar general lighting purposes having:

- a) a rated wattage up to and including 26 W,
- b) a rated voltage up to and including 250 V, and
- c) Edison screw E 14 and E 27 or bayonet caps B 15d and B 22d.

These performance requirements are additional to the safety requirements given in Part 1 of this standard.

**2 REFERENCES**

The following Indian Standards are necessary adjuncts to this standard:

<i>IS No.</i>	<i>Title</i>
6873 ( Part 5 ) : 1999	Methods of measurements of electromagnetic interference: Part 5 From fluorescent lamps and luminaires
15111 ( Part 1 ) : 2002	Self ballasted lamps for general lighting services: Part 1 Safety requirements

**3 TERMINOLOGY****3.1 Self-Ballasted Lamp**

A tubular fluorescent or other discharge lamp unit that incorporates, permanently enclosed, all elements that are necessary for starting, and for stable operation, and which does not include any replaceable or interchangeable parts.

**3.2 Type**

Lamps that, independent of the type of cap or base, are identical in photometric and electrical rating.

**3.3 Rated Voltage**

The voltage or the voltage range marked on the lamp.

**3.4 Test Voltage**

The voltage at which tests are carried out.

**3.5 Rated Wattage**

The wattage marked on the lamp.

**3.6 Rated Frequency**

The frequency marked on the lamp or declared as such by the manufacturer or responsible vendor.

**3.7 Rated Luminous Flux**

The flux marked on the lamp or declared as such by the manufacturer or responsible vendor.

**3.8 Lumen Maintenance**

The luminous flux at a given time in the life of a lamp divided by the initial value of the luminous flux of the lamp and expressed as a percentage of the initial luminous flux.

**3.9 Initial Values**

The photometric and electrical characteristics at the end of 100 h ageing period.

**3.10 Life ( of an Individual Lamp )**

The length of time during which a complete lamp operates to burn out or to any other criterion of life performance laid down in this standard.

**3.11 Average Life ( Life to 50 Percent Failures )**

The length of time during which 50 percent of the lamps reach the end of their individual lives.

**3.12 Rated Average Life ( Rated Life to 50 Percent Failures )**

The life declared by the manufacturer or responsible vendor as being the expected time at which 50 percent of any large number of lamps reach the end of their individual lives.

**3.13 Colour**

The colour characteristics of a lamp are defined by the colour appearance and the colour rendition:

- a) The actual colour of the lamp is called colour appearance and is defined in terms of the spectral tristimulus values ( colour

co-ordinates ) according to the recommendations of the CIE; and

- b) The spectral characteristics of the light emitted by the lamp have an effect on the appearance of the objects it illuminates; this effect is called colour rendition.

### 3.14 Rated Colour

The colour appearance as declared by the manufacturer or responsible vendor, or the colour corresponding to the colour designation marked on the lamp.

### 3.15 Starting Time

The time needed, after the supply voltage is switched 'on' for the lamp to start fully and remain alight.

### 3.16 Run up Time

The time needed, after the supply voltage is switched 'on' for the lamp to reach 80 percent of its final luminous flux.

### 3.17 Stabilization Time

The burning time of the lamp required to obtain stable operating electrical and photometric characteristics.

### 3.18 Type Test

A 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.

### 3.19 Type Test Sample

A sample consisting of one or more similar units submitted by the manufacturer or responsible vendor for the purpose of type test.

### 3.20 Batch

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

### 3.21 Inspection Test Quantity ( ITQ )

The number of lamps selected for the purpose of determining the acceptability of a batch as to dimensions and starting test.

### 3.22 Rating Test Quality ( RTQ )

The number of lamps selected for the purpose of determining the acceptability of a batch as to initial readings and colour.

### 3.23 Life Test Quantity ( LTQ )

The number of lamps selected for the purpose of determining the acceptability of a batch as to life performance.

### 3.24 Acceptance Test

Tests carried out on samples taken from a lot for the purpose of acceptance of the lot.

### 3.25 Lamp Efficiency ( lumen/W )

Luminous flux of a lamp per unit of power consumed at the rated voltage and frequency.

### 3.26 Initial Readings

The initial readings are the measurements of the luminous and electrical characteristics, excluding the checking of starting voltages, made at the end of the 100 h ageing period.

## 4 SELECTION OF LAMPS FOR TESTS ( SAMPLING )

### 4.1 Method of Selection

The inspection test quantities ( ITQ ) as specified shall be selected in a mutually agreed manner such as to ensure proper representation of the batch.

4.1.1 The selection of inspection test quantity ( ITQ ) ( *see* 17.1.1 ) for individual batches shall be made as follows:

- a) *Up to and including 20 containers per batch* — Out of every container an agreed number of lamps (or as near to equal as possible) shall be selected at random in order to obtain 20 lamps required; and
- b) *Over 20 containers per batch* — Out of 20 containers, evenly distributed over the whole batch, one lamp shall be selected at random from each container to obtain 20 lamps required.

### 4.2 Rating Test Quantity ( RTQ )

Rating test quantity consisting of 15 lamps shall be selected at random from the lamps, which have passed the inspection test. The RTQ shall comprise of the test as given in 17.1.2.

### 4.3 Life Test Quantity ( LTQ )

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

### 4.4 Accidentally Broken and/or Incorrected 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 calculation of life test results.

NOTE — In order to avoid unnecessary delay it is recommended that spare lamps be available through the tests.

#### 4.5 Test for Harmonics

The number of sample for this test shall be one.

### 5 CONDITIONS OF COMPLIANCE

#### 5.1 General Conditions

A batch shall be considered as conforming to this standard if the requirements contained in 5.2 to 5.6 are fulfilled. If the batch fails to satisfy the requirements of any of these clauses, it shall be deemed not to comply with the standard.

#### 5.2 Inspection Tests

5.2.1 A batch shall be considered to comply with the requirements of inspection tests, if the number of lamps failing does not exceed the qualifying limits given below:

	<i>Qualifying Limits</i>
a) For any single requirements	2
b) For all the requirements taken together	4

#### 5.3 Acceptance Tests

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

	<i>Qualifying Limits</i>
a) For initial luminous flux of individual lamps	4
b) For wattage of individual lamp	4
c) Starting time	2
d) For all the requirements taken together	5

#### 5.4 Run-up Time, Colour and Power Factor

Compliance shall be considered to be achieved if all the three lamps of the RTQ ( *see* 4.2 ) meet the requirements of 8, 10, 16 and 18 of this standard.

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

#### 5.5 Life and Lumen Maintenance

A batch shall be considered to comply with the requirements of life if the total number of lamps having

lives shorter than 2 000 h together with those failing to meet the requirements of lumen maintenance, does not exceed two.

#### 5.6 Harmonics

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

### 6 DIMENSIONS

The lamp dimensions shall comply with the requirements as indicated by the manufacturer or responsible vendor.

### 7 TEST CONDITIONS

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

### 8 STARTING AND RUN-UP

8.1 The lamps shall fully light up and remain alight within 4.0 s when measured as per A-2.

8.2 The time to reach 80 percent of the initial lumen characteristics shall not exceed 120 s when measured as per A-2.

### 9 LAMP WATTAGE

The power dissipated by the lamp including ballast shall not differ from the rated wattage by more than +15 percent, -10 percent, when measured as per A-3.

### 10 LUMINOUS FLUX

The initial luminous flux measured after the ageing time shall be not less than 90 percent of the rated luminous flux. The value of luminous flux shall be expressed in lumen.

NOTE — The minimum rated luminous flux shall be derived from the value of rated wattage and the value of efficacy corresponding to the colour temperature ( *see* Table 2 ).

### 11 COLOUR

The colour coordinates of a lamp shall be within the tolerance area on the chromaticity chart as declared by the manufacturer or responsible vendor, but shall in any case be within 5 SDCM from the target values.

For further information, *see* Annex B.

### 12 LUMEN MAINTENANCE

After 2 000 h of operation, including the ageing period, the lumen maintenance shall be not less than 90 percent of the initial luminous characteristics.

### 13 LIFE

13.1 The life to 50 percent failures ( average life )

measured on 'n' lamps shall be not less than the rated life to 50 percent failures.

( 'n' is declared by the manufacturer or the responsible vendor, but shall be a minimum of 10 lamps. )

13.2 The average life shall not be less than 6 000 h.

14 HARMONICS

14.1 The harmonics of the input current when measured in accordance with IS 6873 ( Part 5 ) shall not exceed the limits given in Table 1.

Table 1 Limits of Harmonics Current

Harmonic Order <i>N</i>	Minimum Value Expressed as a Percentage of the Fundamental Current
(1)	(2)
2	5
3	30 $\lambda$ <sup>1)</sup>
5	7
7	4
9	3
11 $\leq n \leq$ 39	2

<sup>1)</sup>  $\lambda$  is the circuit power factor.

15 LAMP EFFICACY

The efficiency of the individual lamp shall be as given in Table 2.

Table 2 Values of Lamp Efficacy  
( Clauses 10 and 15.1 )

Lamp Wattage ( <i>W</i> )	Lumen/W for 2 700 K	Lumen/W for 4 000 K	Lumen/W for 6 500 K
(1)	(2)	(3)	(4)
Up to and including 7	45	44	42
8 to 10	50	49	47
11 to 15	55	54	51
16 to 23	60	59	56
24 to 26	60	59	56

16 POWER FACTOR

The power factor of the combination of the ballast and the lamp shall be not less than 0.85.

17 TESTS

17.1 Classification of Tests

17.1.1 Inspection Test

The following shall constitute inspection test:

- a) Dimensions ( see 6 ), and
- b) Starting and run-up ( see 8 ).

17.1.2 Acceptance Test

The following shall constitute as acceptance test:

- a) Dimensions ( see 6 ),
- b) Starting and run-up ( see 8 ),
- c) Lamp wattage ( see 9 ),
- d) Luminous flux ( see 10 ),
- e) Colour ( see 11 ), and
- f) Power factor ( see 16 ).

17.1.3 Type Test

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

- a) Dimensions ( see 6 ),
- b) Starting and run-up ( see 8 ),
- c) Lamp wattage ( see 9 ),
- d) Luminous flux ( see 10 ),
- e) Colour ( see 11 ),
- f) Lumen maintenance ( see 12 ),
- g) Life ( see 13 ),
- h) Harmonics ( see 14 ),
- j) Lamp efficacy ( see 15 ), and
- k) Power factor ( see 16 ).

## ANNEX A

( Clause 7.1 )

### METHOD OF MEASURING LAMP CHARACTERISTICS

#### A-1 GENERAL

All tests shall be made in a draught-free room at an ambient temperature of  $27 \pm 2^\circ\text{C}$  and a relative humidity of 65 percent maximum.

The test voltage shall be stable within  $\pm 0.5$  percent, during stabilization periods, this tolerance being reduced to  $\pm 0.2$  percent at the moment of measurements. For life 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 component 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 a free air in a vertical base-up position for all test including life test.

Electrical and photometric instruments used shall be selected having a guaranteed accuracy commensurate with the requirements of the test.

#### A-2 STARTING AND RUN-UP

The starting and run-up tests shall be made before ageing except in the case of lamps declared by the manufacturer to be VPC (vapor pressure control) types, where the following procedure shall be carried out.

VPC lamps are aged for a period of at least 100 h, of normal operation and then switched off for at least 24 h before the run-up test performed. The starting test for VPC lamps shall be performed both before ageing and at the commencement of the run-up test.

The test voltage for the starting test shall be equal to 92 percent of the rated voltage or, in case of a voltage range, 92 percent of the minimum value of that range.

For run-up the test voltage is increased to the rated voltage or case of a lamp with a voltage range, increase to the mean value of the voltage range.

#### A-3 ELECTRICAL AND PHOTOMETRIC CHARACTERISTICS

##### A-3.1 Test Voltage

The test voltage shall be the rated voltage. In the case of a voltage range, measurements shall be carried out at the mean value.

##### A-3.2 Ageing

Lamps shall have been aged for a period of 100 h of normal operation.

##### A-3.3 Stabilization Time

Lamps shall be measured at the test voltage immediately after the stabilization period as stated by the manufacturer or responsible vendor.

#### A-4 LAMP LIFE AND LUMEN MAINTENANCE

##### A-4.1 Ambient

Ambient temperature shall be kept within the range of  $15^\circ\text{C}$  to  $40^\circ\text{C}$ . Excessive draught should be avoided and the lamps should not be subjected to extreme vibration and shocks.

These conditions are under consideration.

##### A-4.2 Test Voltage

The test voltage shall be the rated voltage with a tolerance of  $\pm 2$  percent. In the case of a voltage range, measurements shall be carried out at the mean value.

##### A-4.3 Switching ON and OFF

Lamps on lumen maintenance and life test shall be switched off 8 times in every 24 h running. The 'off' period shall be between 10 min and 15 min. The 'on' period shall be at least 10 min.

##### A-4.4 Establishing of Average Life

The average life shall be derived from a test quantity of at least 10 lamps.



ANNEX B

( Clause 11 )

COLOUR

B-1 GENERAL

This annex covers the standardized rated values and tolerance areas for the chromaticity co-ordinates  $x$  and  $y$  applying to fluorescent lamps.

For lamps with non-standardized chromaticity co-ordinates, the rated values shall be assigned by the manufacturer or responsible vendor.

NOTE — The chromaticity co-ordinates  $x$  and  $y$  are specified according to the CIE 1931 Standard Colorimetric system ( see CIE Publication 15-2 ). The tolerance areas are based on the ellipses defined by D.L. MacAdam in his paper "Specification of small chromaticity differences", published in the Journal of the Optical Society of America, vol 1, No. 1 Jan. 1943, pp 18-26.

The tolerance areas are defined by MacAdam ellipses of 5 SDCM ( standard deviation of colour

matching ). Co-ordinates 5 SDCM away from the rated values are given by the equation:

$$g_{11} \Delta x^2 + 2 g_{12} \Delta x \Delta y + g_{22} \Delta y^2 = 5^2$$

In which  $\Delta x$  and  $\Delta y$  represent the deviations with respect to the rated co-ordinates, while the coefficients  $g_{11}$ ,  $g_{12}$  and  $g_{22}$  depend on these rated values. These coefficients are the basis for calculating  $\theta$ ,  $a$  and  $b$ , where  $\theta$  is the angle between the major axis of the ellipse and the  $x$ -axis, and  $a$  and  $b$  are the major and minor semi-axes of an ellipse of 1 SDCM.

B-2 STANDARD CHROMATICITY CO-ORDINATES

For the standardized chromaticity co-ordinates the following rated values  $x$  and  $y$  apply for the different lamp 'colours' ( with the correlated colour temperatures  $T_c$  in kelvin given as extra information ):

Colour	$T_c$	$x$	$y$
F 6500	6 400	0.313	0.337
F 5000	5 000	0.346	0.359
F 4000	4 040	0.380	0.380
F 3500	3 450	0.409	0.394
F 3000	2 940	0.440	0.403
F 2700	2 720	0.463	0.420

For the coefficients  $g_{11}$ ,  $g_{12}$  and  $g_{22}$ , the following values shall apply:

Colour	$g_{11}$	$g_{12}$	$g_{22}$
F 6500	$86 \times 10^4$	$-40 \times 10^4$	$45 \times 10^4$
F 5000	$56 \times 10^4$	$-25 \times 10^4$	$28 \times 10^4$
F 4000	$39.5 \times 10^4$	$-21.5 \times 10^4$	$26 \times 10^4$
F 3500	$38 \times 10^4$	$-20 \times 10^4$	$25 \times 10^4$
F 3000	$39 \times 10^4$	$-19.5 \times 10^4$	$27.5 \times 10^4$
F 2700	$44 \times 10^4$	$-18.6 \times 10^4$	$27 \times 10^4$

For  $\theta$ ,  $a$  and  $b$ , the following values shall apply:

<i>Colour</i>	$\theta$	$a$	$b$
F 6500	58° 23'	0.002 23	0.000 95
F 5000	59° 37'	0.002 74	0.001 18
F 4000	54° 00'	0.003 13	0.001 34
F 3500	52° 58'	0.003 17	0.001 39
F 3000	53° 10'	0.002 78	0.001 36
F 2700	57° 17'	0.002 58	0.001 37

The tolerance are as shown in Fig. 1 to 3, together with the rated values, a part of the black body locus, and lines of constant correlated colour temperature.

### B-3 SHIFTED CHROMATICITY CO-ORDINATES

For some lamps, slightly shifted chromaticity

co-ordinates apply, but only for types having a general colour rendering index less than 80.

The same tolerance areas as given in B-2 shall be used, but centred on the rated values given in the following table:

<i>Colour</i>	$x$	$y$
F 6500	0.309	0.337
F 5000	0.342	0.359
F 4000	0.375	0.380
F 3500	0.403	0.394
F 3000	0.433	0.403
F 2700	—	—

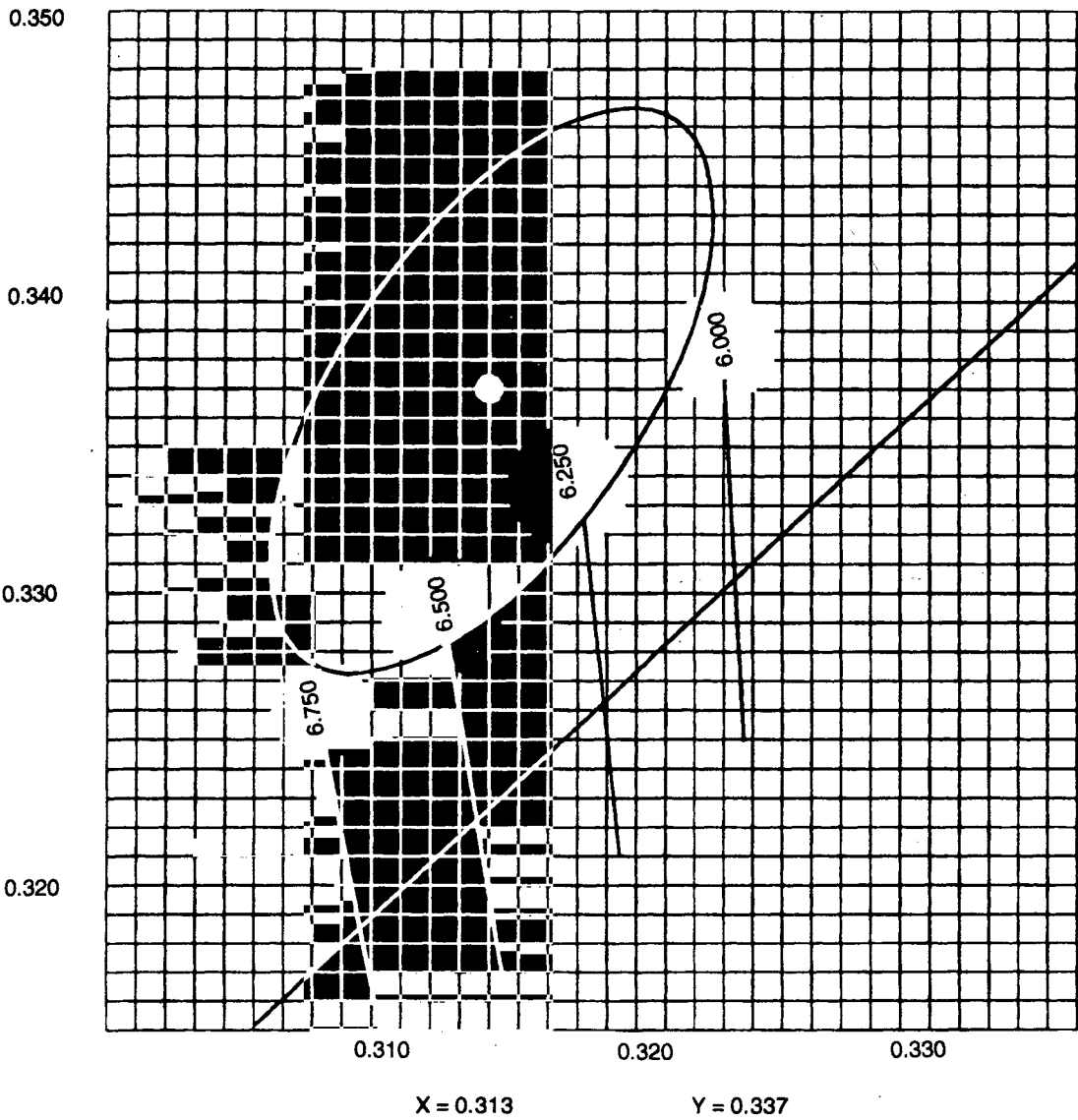


FIG. 1 TOLERANCE AREA FOR STANDARD 'COLOUR' 6500 k

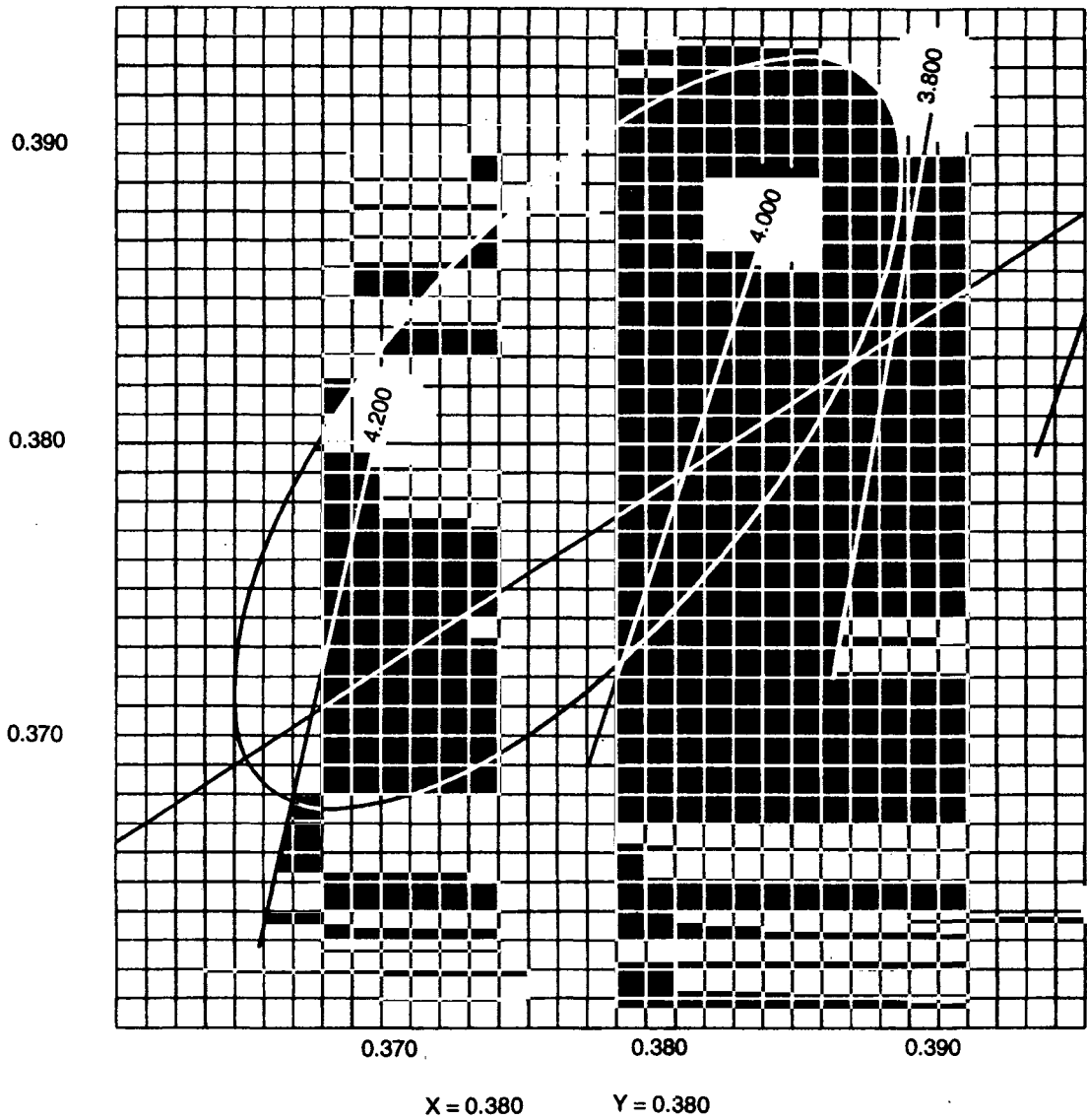


FIG. 2 TOLERANCE AREA FOR STANDARD 'COLOUR' 4000 k

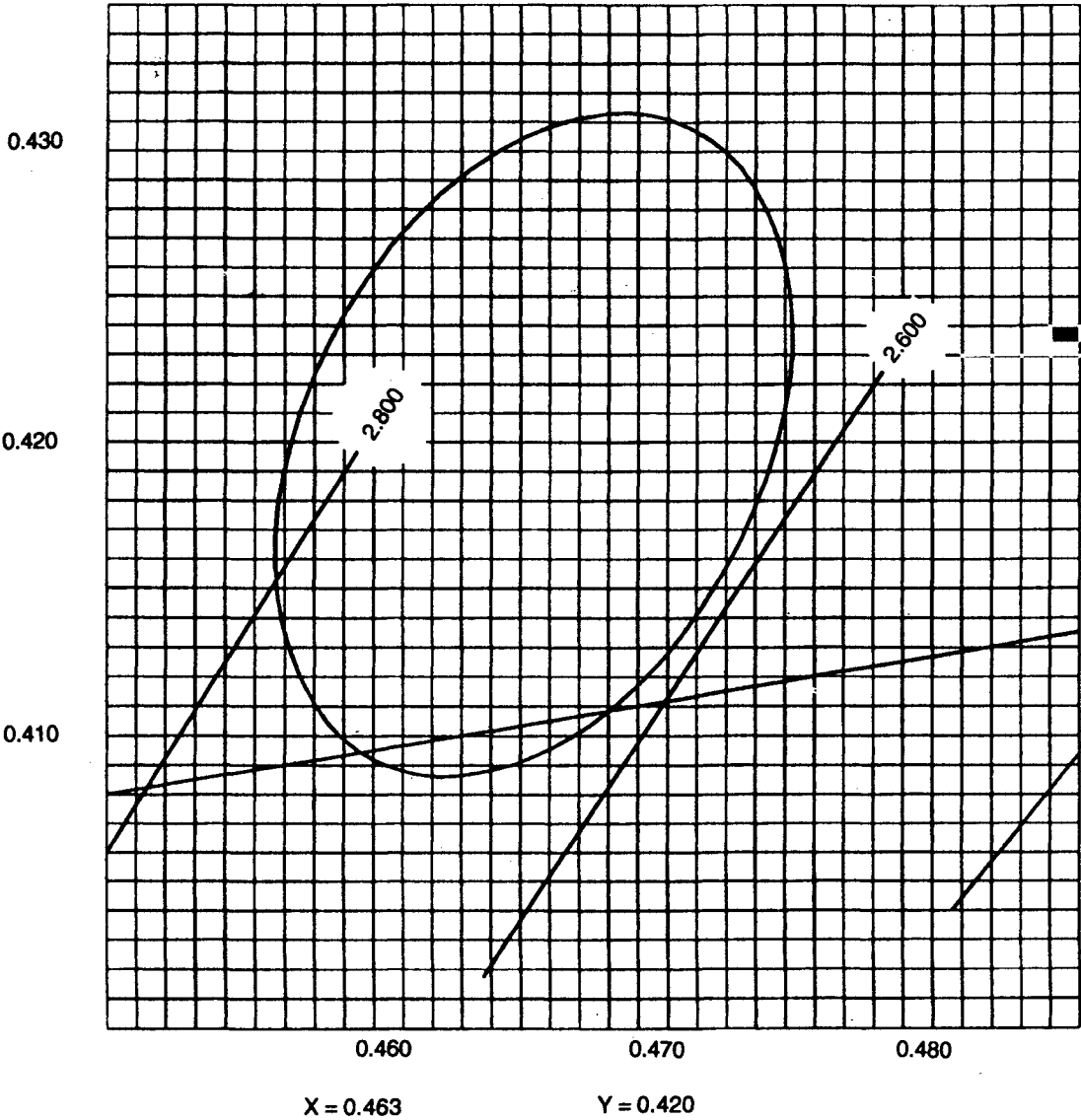


FIG. 3 TOLERANCE AREA FOR STANDARD 'COLOUR' 2700 k

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