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SRI LANKA STANDARD SPECIFICATION FOR

ENERGY EFFICIENCY RATING FOR SELF-BALLASTED INTEGRAL TYPE COMPACT FLUORESCENT LAMPS FOR GENERAL LIGHTING SERVICES

(First Revision)

SRI LANKA STANDARDS INSTITUTION

Sri Lanka Standard Specification for
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SLS 1225 : 2016

Gr. 8

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This standard does not purport to include all the necessary provisions of a contract.

Sri Lanka Standard Specification for ENERGY EFFICIENCY RATING FOR SELF-BALLASTED INTEGRAL TYPE COMPACT FLUORESCENT LAMPS FOR GENERAL LIGHTING SERVICES (First Revision)

FOREWORD

This Sri Lanka standard for Energy Efficiency Rating for Integral type compact fluorescent lamps was authorized for adoption and publication as a Sri Lanka Standard by the Council of the Sri Lanka Standards Institution on 2016 -07 -22 after the draft finalized by the Technical Committee and the Advisory Committee for Appliance Energy Labelling of the Sri Lanka Sustainable Energy Authority and had been approved by the Sectoral Committee on Electrical Appliances and Accessories.

This is the first revision of **SLS 1225.** This revision introduces new requirements for luminous flux, wattage and colour correction coefficient. In calculation of efficacy for CFLs having rated wattage greater than 23 W, only rated wattage is considered excluding the 0.4 W under this revision. Further CFLs with rated wattage greater than 60 W will be assigned star rating in accordance with the Table **3** specified in **7.3.2.**

This Sri Lanka Standard Specification for Energy efficiency rating for Compact Fluorescent Lamps has been published for the promotion of the use of efficient lamps for saving electrical energy. Five categories of energy efficiency ratings have been identified based on the efficacy and power factor of the lamp. The best energy efficiency rating is assigned with "five stars". The number of stars assigned reflects the efficiency of the model of the lamp. More stars means more energy efficient.

This standard specifies method of determination of the efficiency ratings by a number of stars assigned for a specific rating. It also specifies methods of measurement of luminous flux, power consumption and the requirements for the energy label, which should be displayed on the container of the lamp. The label carries the approved number of stars for a particular model of the lamp.

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 measurement, shall be rounded off in accordance with **SLS 102**. The number of significant figures to be retained in the rounded off value shall be the same as that of the specified value in this standard.

All the values given in this specification are in SI units.

In the preparation of this standard, the Sri Lanka Standards Institution and the Sri Lanka Sustainable Energy Authority gratefully acknowledge the use of following publications.

a) **IEC 60969: 2001** Self ballasted lamps: Performance requirements, of the International Electrotechnical Commission,
b) **JIS C 7607 : 1991** Total luminous flux measurements on discharge lamps used for photometric standards of the Japanese Standards Association and
c) **CIE 84 : 1989** Report on Measurement of Luminous flux of the International Technical Commission on Illumination.

∗ CIE – International Technical Commission on Illumination

1. SCOPE

This standard specifies requirements for energy efficiency labelling of self-ballasted lamps operating on mains supply of 230 V, a.c. 50 Hz nominal, and method of measurement of electrical energy consumption and luminous flux for determination of efficiency of the lamps for the purpose of energy efficiency labelling. The standard also specifies dimensions, colours and the contents of the energy efficiency label.

2. REFERENCES

ISO 15076-1: Image technology colour management – Architecture, profile format and data structure Part 1: Based on ICC.1: 2004-10

SLS 1231 Self ballasted lamps and modular type compact fluorescent lamps for general lighting services. Part 2 Safety requirements.

3. DEFINITIONS

For the purpose of this standard following definitions shall apply:

3.1 ballast: A device connected between the supply and one or more discharge lamps, which serves mainly to limit the current of the lamp(s) to the required value. It may include means for transforming the supply voltage and/or frequency, correcting the power factor and, either above or in combination with a starting device, provides the necessary conditions for starting the lamp(s).

3.2 efficacy: A measure of the ability of radiation to produce visual sensation;

$$\text{Efficacy of radiation} = \frac{\text{luminous flux (1m)}}{\text{radiant flux (W)}}$$

3.3 initial values: The photometric and electrical characteristics at the end of 100 h ageing period.

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

3.5 light receiver: The light receiving part of a photometer consisting of combination of photoelectric device, diffuse transmitting plate(s) (including diffuse transmitting plate of photometric window of integrating sphere) and optical filter(s). It sometimes includes an amplifier.

3.6 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.

3.7 luminous flux: In the visible radiation range, the radiant flux is considered to associate with luminous flux (Ø) which is a measure of the visual response. The unit of luminous flux is lumen.

3.8 photometric window: A window structured in such a way, that a diffuse transmitting plate with a possible flat spectral transmitting characteristic in visual region is set in a small hole perforated on the wall of an integrating sphere, so that no unevenness appears in the inside wall of the sphere.

3.9 power factor = $\dfrac{\text{useful (real) power}}{\text{total apparent power}}$

3.10 rated average life (rated life to 50% failures): The life declared by the manufacturer or responsible vendor as being the expected time at which 50% of any large number of lamps reach the end of their individual lives.

3.11 rated luminous flux: The flux marked on the lamp or declared as such by the manufacturer or responsible vendor.

3.12 rated voltage: The voltage or the voltage range marked on the lamp by the manufacturer or responsible vendor.

3.13 rated wattage: The wattage marked on the lamp by the manufacturer or responsible vendor.

3.14 screen (in an integrating sphere) : A white diffuse reflecting plate painted same as the inner wall of the integrating sphere which screens the direct light radiated from the light emitting part and the scattered light from the glass bulb of the lamp to be measured so that such light does not reach the photometric window directly.

3.15 self-ballasted lamp: A unit, which cannot be dismantled without being permanently damaged, provided with a lamp cap and incorporating a light source and any additional element necessary for starting and stable operation of the light source.

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

3.17 total harmonic distortion (THD): The THD is defined as follows:

$$THD = \frac{\sqrt{\sum_{r=2}^{n} (I_r)^2}}{I_1}$$

where,

I_r = r.m.s. value of the r^{th} harmonic component of the current.

I_1 = the r.m.s value of the fundamental component of the current.

n = highest significant harmonic.

3.18 visible radiation: Any optical radiation capable of causing a visual sensation directly.

NOTE : *There are no precise limits for the spectral range of visible radiation since they depend upon amount of radiant power reaching the retina and the responsivity of the observer. The lower limit is generally taken between 360 nm and 400 nm and the upper limit between 760 nm and 830 nm.*

4. REQUIREMENTS

4.1 Lamp wattage

The initial wattage dissipated by the lamp shall not deviate by more than +15 per cent and -10 per cent of the rated wattage when measured as prescribed in **6.3.5.**

4.2 Rated average life

The supplier shall declare the rated average life of lamps, which shall be not less than 6000 h.

4.3 Efficacy

The efficacy shall be determined in accordance with **7.1**.

4.4 Power factor

The power factor of the lamps shall be greater than 0.50 when tested in accordance with **6.3.5.**

4.5 Luminous flux

The initial luminous flux of each individual lamp after the ageing period (see **6.3.2**) shall not deviate by more than +15 per cent and -10 per cent of the rated luminous flux.
The average initial luminous flux of the lamps in the sample containing minimum of 3 lamps shall not be less than 92 per cent of the rated luminous flux.

4.6 Lumen maintenance

After 2000 h of operation, including the ageing period the lumen maintenance shall be not less than 80 per cent of the initial lumen value of each lamp.

4.7 Starting

When a lamp is switched on, it shall start without any undue delay.

5. MARKING

5.1 Lamps shall be marked with the following information:

a) Brand name;
b) Rated wattage;
c) Rated voltage and frequency
d) Model number.

5.2 The rated average life and rated luminous flux shall be marked on the lamp or the container.

5.3 In addition to the above the lamps shall comply with the markings given in SLS **1231 Part 2.**

6 TESTS

6.1 Sampling and criteria for acceptance

A sample containing 3 lamps shall be selected randomly for testing from a population of minimum 50 lamps or more, except for the life test and lumen maintenance.

a) Lumen maintenance

For lumen maintenance minimum sample size shall be 5 lamps and the total rate of failure shall not exceed 20 per cent.

If the first sample of lamps fails, a repeat test may be carried out on another sample of 5 lamps minimum and all lamps of the sample shall comply.

b) Life test

The average life shall be derived from a test quantity of at least 20 lamps.

6.2 General test conditions.

a) The test voltage 230 V shall be stable within ± 0.5 per cent at 50 Hz during stabilization period, this tolerance being reduced to ± 0.2 per cent at the moment of measurement. For life testing the voltage tolerance is 2 per cent. The total harmonic content of the supply voltage shall not exceed 3 per cent.

b) The lamp to be measured shall be operated with its base placed vertically upward while its light centre coincides with the centre of the integrating sphere.

6.3 Electrical and photometric characteristics

6.3.1 *Test Environment*

6.3.1.1 Temperature

Tests shall be made in a draught–proof room. The temperature of the test room shall be in the range of 20 ^{0}C to 30 ^{0}C, and shall be controlled and maintained at a constant temperature as far as possible during the measurements. The temperature inside the integrating sphere shall be controlled within the range 25 ± 1 ^{0}C.

The temperature sensor shall be placed at a distance from the sphere wall between 200 mm and 1/3 of the sphere diameter. The temperature sensor must be shielded from irradiation by the source to be measured.

6.3.1.2 Humidity

The relative humidity of the test room shall be 65 per cent maximum.

6.3.1.3 Vibration

The vibration shall be of such a degree that the measurements are not affected.

6.3.2 *Ageing*

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

6.3.3 *Stabilization*

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

6.3.4. *Measuring Instruments*

6.3.4.1 Electrical Measuring Instruments

Instruments used for measurement of electrical characteristics shall be a.c digital instruments of accuracy within 0.2 per cent, which shall measure and indicate the r.m.s. (true) value.

The impedance of an instrument which is connected in parallel to the lamp shall be sufficiently high so that the shunt current is not greater than 0.1 per cent of the lamp current, and the impedance of an instrument which is connected in series to the lamp shall be sufficiently low so that the voltage drop is not greater than 1 per cent of the voltage across the lamp.

Calibration uncertainties (at 95% confidence level with a covering factor of 2) of AC voltage and current measuring instruments shall not be greater than 0.2 per cent. Calibration uncertainty of power measuring instrument shall not be greater 0.5 per cent.
The power factor shall be determined using the true r.m.s. meters.
The harmonic analyzer shall be able to measure up to the 25^{th} harmonic.

6.3.4.2 Photometric Measuring Instruments

The instruments used to measure the photometric characteristics shall be as follows:

a) **Integrating sphere:** The inner diameter of the integrating sphere shall be at least 10 times the largest dimension of the light source. The inside surface of integrating sphere, screen, support of lamp to be measured, etc. shall be painted with white diffusion reflecting material having possible flat spectral reflecting characteristics in the visual region (for example barium sulphate powder) so that various parts have uniform reflectivity and form surfaces close to uniform diffusing plane.

The screen shall be a white diffusion reflecting plate painted same as the inner wall of the integrating sphere which screens the direct light radiated from the light emitting part of and the scattered light from the glass bulb of the lamp to be measured operated at the centre of the integrating sphere so that such light does not reach the photometric window.

b) **Light receiver:** The light receiver for total luminous flux measurement shall be those employing silicon photodiode or phototube as the photo electronic device.

6.3.5 *Method of measurement*

The test circuit for photometric and electrical measurements is shown in Figure **1,** as example.

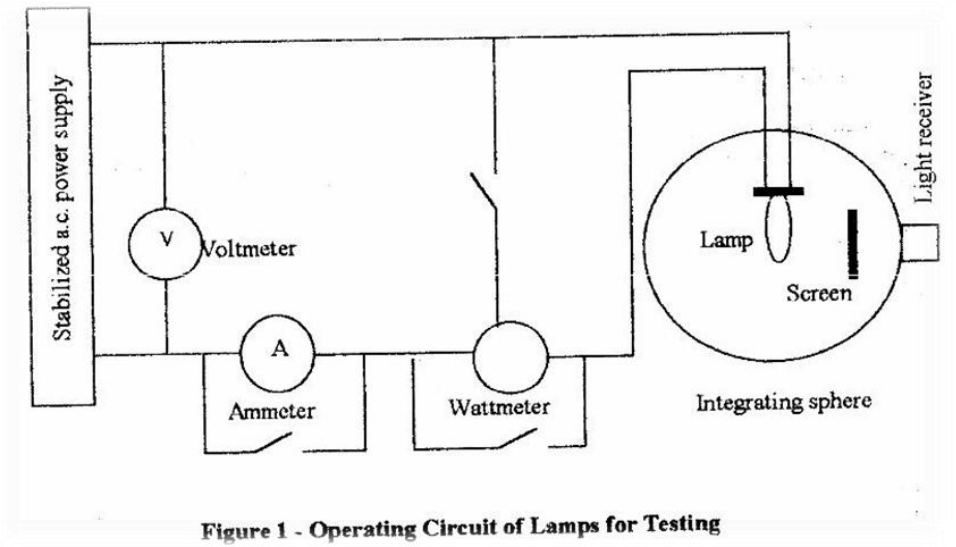

Figure 1 - Operating Circuit of Lamps for Testing

Photometric characteristics shall be measured in accordance with the recommendations of **CIE 84.** (Applicable recommendations for Integrating sphere is given in **6.3.4.2**)

Total luminous flux shall be measured with an integrating sphere. The lamp to be measured shall be operated with its test voltage applied, and the lamp wattage, luminous flux, power factor and total harmonic content shall be measured when the lamp is stabilized.

6.4 Life test and lumen maintenance

6.4.1 Ambient

Ambient temperature shall be kept within the range of 15 ^{0}C to 40 ^{0}C. Excessive draught should be avoided and the lamps should not be subjected to extreme vibration and shocks.

6.4.2 *Switching on and off*

Lamps on lumen maintenance and life test shall be switched off eight times in every 24 h running. The “Off” period shall be between 10 minutes and 15 minutes. The “On” period shall be at least 10 minutes.

6.4.3 *Method*

The lamps shall be operated at the test voltage of conditions specified in a) of **6.2** until 50 per cent of lamps fail. The number of hours taken to fail 50 per cent of the lamps of the sample is the average life.

7 DETERMINATION OF STAR RATING

7.1 The star rating shall be assigned based on the value of the Performance Grading which is calculated as per the following formula and rounded off to one decimal place.

$$PG = E \times A + Pf \times 100 \times B + CCC$$

where,

PG = Performance Grading
E = Efficacy
A=0.9, B=0.1 (weightage factors)
Pf = Power factor
CCC = Colour Correction Coefficient

Colour Correction Coefficient is given in Table **1**.

TABLE 1 – Colour correction coefficient

Colour Temperature	Colour Correction Coefficient
<3300 ° K	0
3300 - 5000 ° K	1
>5000 ° K	2

Efficacy is the average efficacy of the sample determined as in **7.2**. Power factor is the measured average power factor of the sample rounded off to two decimal places. Colour Correction Coefficient is corresponding to the Colour Temperature measured as per the method specified in Appendix **A** of **SLS 1231: Part 1**.

7.2 Determination of the efficacy

For lamps with rated wattage equal or less than 23 W, the efficacy shall be calculated by the following formula.

$$\text{Efficacy} = \frac{\text{Measured average luminous flux (lm)}}{\text{Rated wattage of lamp} - 0.4 \text{ (W)}}$$

For lamps with rated wattage greater than 23 W, the efficacy shall be calculated by the following formula.

$$\text{Efficacy} = \frac{\text{Measured average luminous flux (lm)}}{\text{Rated wattage of lamp (W)}}$$

The efficacy shall be calculated to two decimal places using the average values of the luminous flux and wattage measured in accordance with **6.3.5** and the rated wattage of lamps.

7.3 Assigning the star rating

The model of the lamps shall be assigned with the star rating as in the Table **2** or Table **3** corresponding to the calculated value of the Performance Grading (PG).

7.3.1 For lamps with rated wattage equal or less than 60 W

TABLE 2 - Star rating

PERFORMANCE GRADING (PG)	STAR RATING
PG > 72	Five stars * * * * *
67 < PG ≤ 72	Four stars * * * *
62 < PG ≤ 67	Three stars * * *
57 < PG ≤ 62	Two stars * *
54 < PG ≤ 57	One star *

7.3.2 For lamps with rated wattage greater than 60 W

TABLE 3 - Star rating

PERFORMANCE GRADING (PG)	STAR RATING
PG > 75	Five stars * * * * *
70 < PG ≤ 75	Four stars * * * *
65 < PG ≤ 70	Three stars * * *
60 < PG ≤ 65	Two stars * *
57 < PG ≤ 60	One star *

8 LABELLING

8.1 Lamps shall be labelled with the approved star rating for the model of the lamp. The format of the label shall be as given in Figure **2**. Performance Grading and the number of the stars shall be decided after testing. The detailed description of the label is given below:

8.2

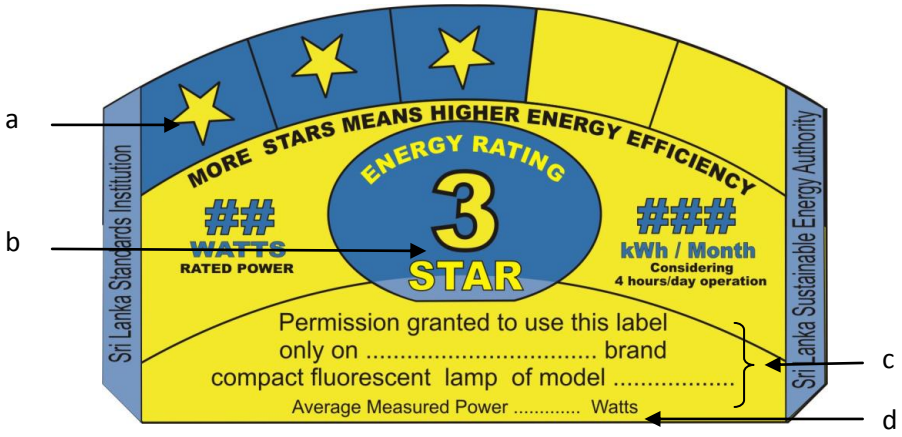

FIGURE 2 – Format for the energy label

a - Number of stars appearing on the curved band depends on the energy rating determined as in **7.2** of the standard. More stars mean higher energy efficient.
b - Number of stars permitted for the model.
c -Brand name and model number of the lamp shall be printed in the space provided
d - Average measured power in Watts

8.2 Sample energy label is given in Figure **3** for information only. The actual size of the label is given in Figure **4**. The colours of the label shall be as shown in the sample label.

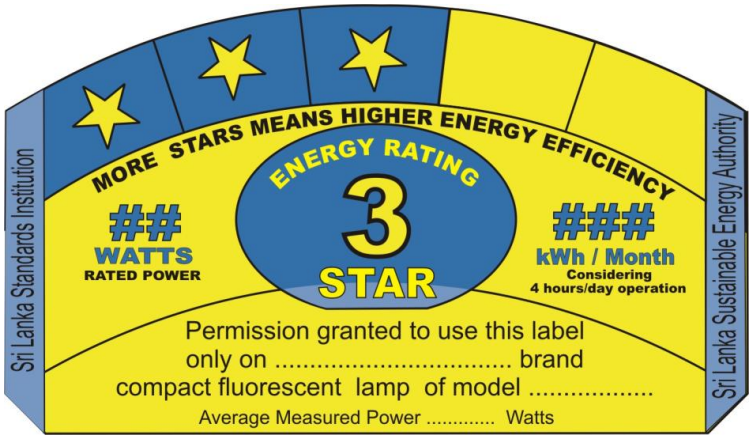

FIGURE 3 – Example of printed energy label

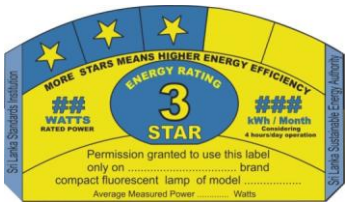

FIGURE 4 – Actual size of the energy label

8.3 Dimensions of the energy label shall be as given in Figure **5**.

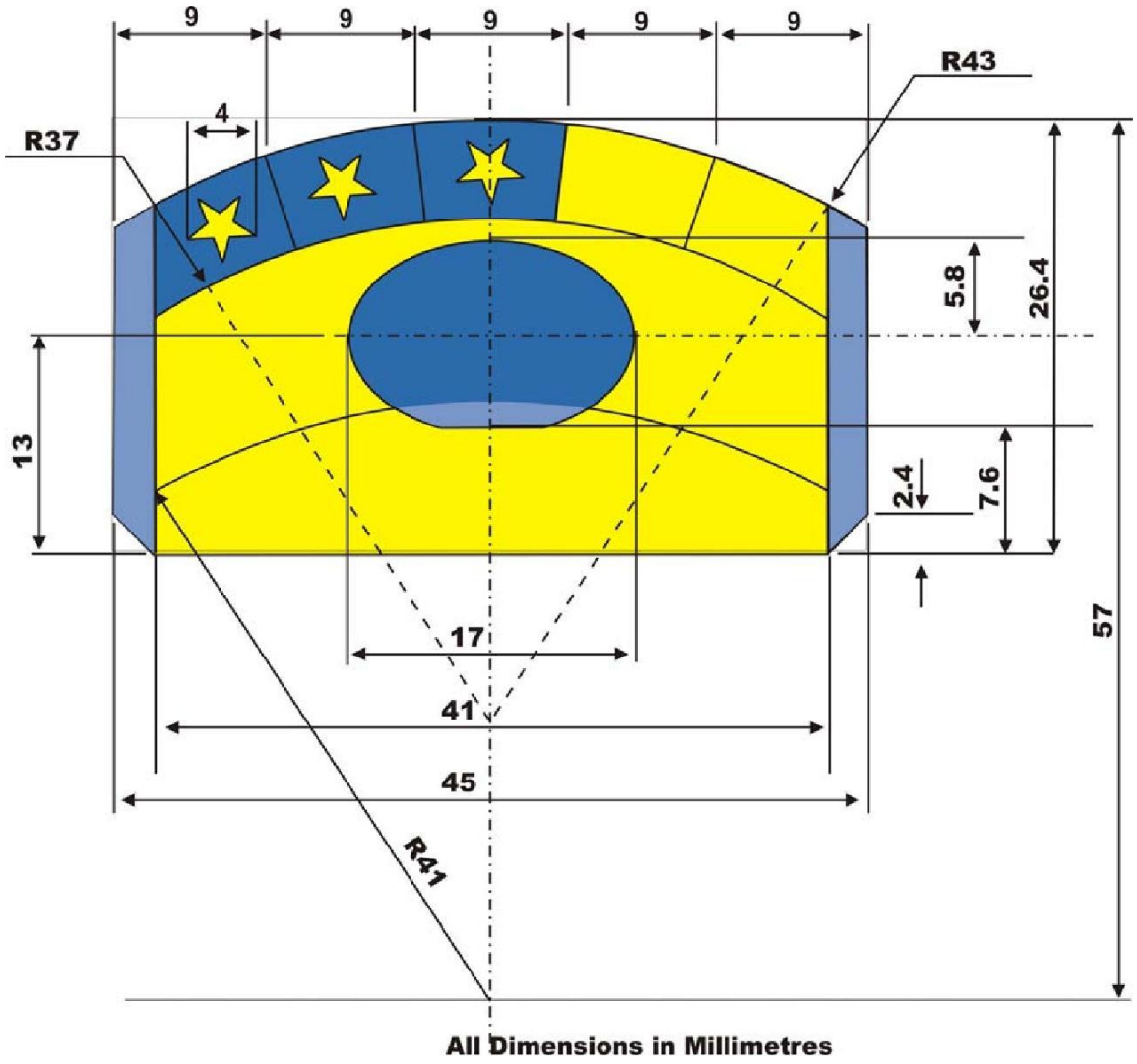

FIGURE 5 – Dimensions of the energy label

8.4 Character size (height) of the label shall be as given in Figure **6**.

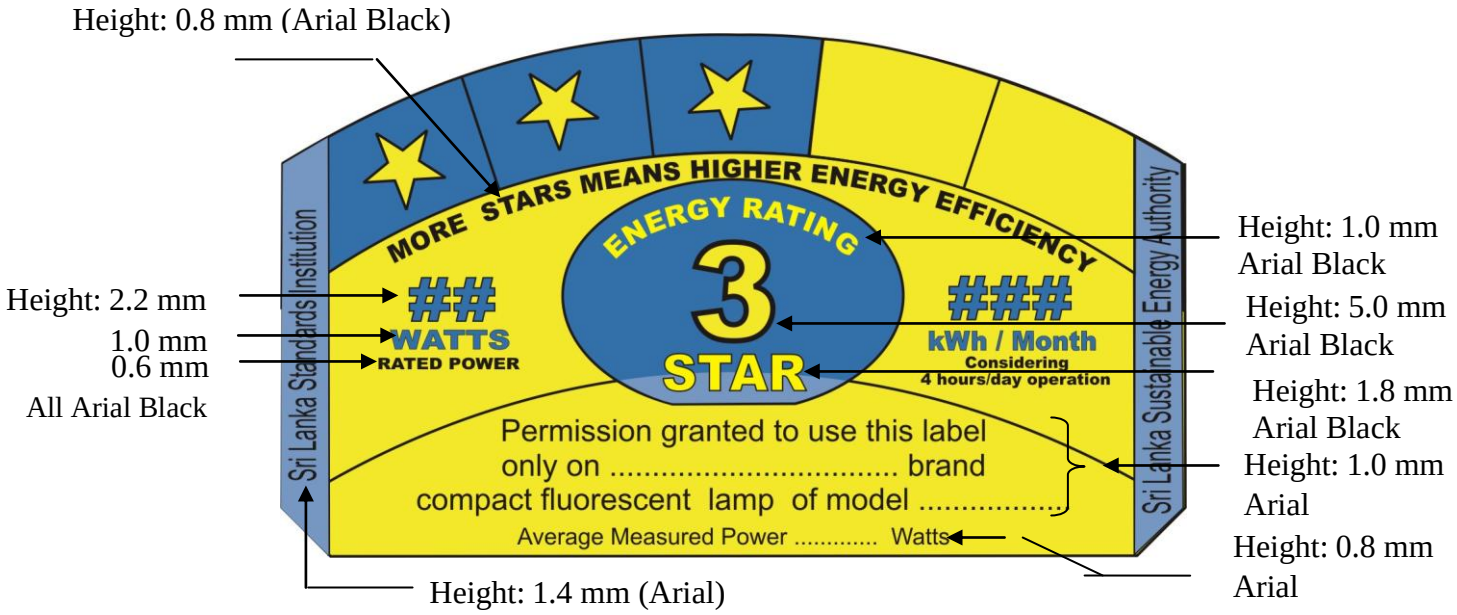

FIGURE 6 – Print type and the character size of the energy label

8.5 The colours of the label shall be CMYK specified in ISO 15076-1:

Dark Blue :	C: 87%	M: 60%,	Y: 2%	K: 1%
Light Blue :	C: 57%	M: 37%,	Y: 6%	K: 0%
Yellow :	C: 7%	M: 0%,	Y: 89%	K: 0%
Black :	C: 75%	M: 68%,	Y: 67%	K: 90%

9 REPORTING RESULTS OF THE MEASUREMENTS

The following items shall be described in the test report:

a) Details of the supplier / manufacturer
b) Brand name and model number of the lamps measured
c) Specifications of the lamps
  i) rated wattage;
  ii) rated voltage/voltage range; and
  iii) rated luminous flux.

d) Measurement results for each lamp
- **i)** luminous flux;
- **ii)** lamp voltage and lamp current;
- **iii)** power factor;
- **iv)** wattage; and
- **v)** ambient temperature and temperature inside the sphere

e) Uncertainty of measurements for following parameters
- **i)** luminous flux;
- **ii)** lamp voltage;
- **iii)** lamp wattage

NOTE 1: *In calculation of the performance grading uncertainty shall be considered;*

NOTE 2: *Uncertainty in this standard refers to the expanded combined uncertainty with 95% confidence level with a coverage factor of k=2.*

NOTE 3: *In determination of compliance or calculation of performance grading, measurement uncertainty will be taken in to account on the basis of stringent acceptance, increasing the confidence that the measurement result is within the specification limits.*

f) Other information for reference.

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