SRI LANKA STANDARD 1231 : PART 1 : 2002
UDC 621.326

SPECIFICATION FOR

SELF-BALLASTED LAMPS (INTEGRAL TYPE COMPACT FLUORESCENT LAMPS) FOR GENERAL LIGHTING SERVICES

PART 1 : PERFORMANCE REQUIREMENTS

SRI LANKA STANDARDS INSTITUTION

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SPECIFICITON FOR SELF-BALLASTED LAMPS (INTEGRAL TYPE COMPACT FLUORESCENT LAMPS) FOR GENERAL LIGHTING SERVICES PART 1 : PERFORMANCE REQUIREMENTS

SLS 1231 : Part 1 : 2002

Gr. 9

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Sri Lanka.

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

SRI LANKA STANDARD
SPECIFICITON FOR SELF-BALLASTED LAMPS FOR GENERAL LIGHTING SERVICES (INTEGRAL TYPE COMPACT FLURASCENT LAMPS) PART 1: PERFORMANCE REQUIREMENTS

FOREWORD

This standard was approved by the Sectoral Committee on Electrical Appliances and Accessories and was authorized for adoption and publication as a Sri Lanka Standard by the Council of the Sri Lanka Standards Institution on 2002 – 10 –10

This standard is presented in two parts as follows:

Part 1 : Performance requirements
Part 2 : Safety requirements

This part of the standard specifies performance requirements and methods of test for self-ballasted lamps. Part 2 of the standard, dealing with safety requirements is a direct adoption of **IEC 968.** There is a separate standard for single capped compact fluorescent lamps in two parts for performance requirements and safety requirements.

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 **CS 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 gratefully acknowledge the use of publication **IEC 969: 1988** Self ballasted lamps: Performance requirements, of the International Electrotechnical Commission, **JIS C 7607 :1991**Total luminous flux measurements on discharge lamps used for photometric standards of the Japanese Standards Association, and **CIE 84 : 1989** International Technical Commission on Illumination - Report on Measurement of Luminous flux.

1 SCOPE

This part of the standard specifies the performance requirements and methods of tests for 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 services having:

a) a rated wattage up to 60 W;
b) a rated voltage of 100 V to 250 V; and
c) Edision screw or bayonet caps.

2 REFERENCES

***** CIE 84 Report on Measurement of Luminous flux
CS 102 Presentation of Numerical Values

3 DEFINITIONS

For the purpose of this standard following definitions shall apply.

3.1 average life (life to 50% failures) : The length of time during which 50% of the lamps reach the end of their individual lives

3.2 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 alone or in combination with a starting device, provide the necessary conditions for starting the lamp(s).

3.3 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)

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

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

3.5 life (of and individual lamp):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.

3.6 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 associated with luminous flux (Ø) which is a measure of the visual response. The unit of luminous flux is lumen

$$\textbf{3.8 power factor} = \frac{\text{useful (real) power}}{\text{total apparent power}}$$

3.9 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.

***** CIE - International Technical Commission on Illumination

3.10 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.

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

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

3.13 rated voltage : The voltage or voltage range marked on the lamp.

3.14 rated wattage : The wattage marked on the lamp.

3.15 run-up time : The time needed, after the supply voltage is switched on, for the lamp to reach 80% of its final luminous flux.

3.16 self-ballasted lamps : A unit which cannot be dismantled without being permanently damaged, provided with a lamp cap and elements necessary for starting and stable operation of the light source.

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

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

3.19 test voltage : The voltage at which tests are carried out.

3.20 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.

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

3.22 type test : A test or series of tests made on a type test sample for the purpose determining compliance of the design of a given product with the requirements of the relevant standard.

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

3.24 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 760nm and 830 nm.

3 REQUIREMENTS

4.1 Dimensions

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

4.2 Starting and run-up

The starting and run-up time shall comply with the values as indicated by the manufacturer or responsible vendor. Method of test is given in **6. 3**.

4.3 Lamp Wattage

The initial power dissipated by the lamp shall not exceed 115 percent & wattage when measured an prescribed in **6.4.5**

4.4 Luminous flux

The initial luminous flux measured after the ageing time shall be not less than 90% of the rated luminous flux. Method of measurements is given in **6. 4 .5**

4.5 Colour

a) The initial reading of the chromaticity co-ordinates x and y of a lamp shall be within 5 SDCM (Standard Deviation of Colour Matching) from the rated values.
b) The initial reading of the general colour rendering index R_a of a lamp shall be not less than the rated value decreased by three.

Further information is given in Appendix **A.**

4.6 Lumen maintenance

After 2 000 h of operation, including the ageing period, the lumen maintenance shall be not less than the value declared by the manufacturer or responsible vendor.

4.7 Life

The life to 50% failures (average life) measured on "n" lamps shall be not less that the rated life to 50% failures.
("n" is declared by the manufacturer or responsible vendor, but shall be a minimum of 20 lamps)

4.8 Harmonics

4.8.1 If the lamp active input power > 25 W, the harmonic currents shall not exceed the relative limits given in Table 1.

TABLE 1 - Harmonic current limits for lamps with active input power > 25 W

Harmonic Order n	**Maximum permissible harmonic current expressed as a percentage of the input current at the fundamental frequency - %**
(1)	**(2)**
2	2
3	30. *l* *
5	10
7	7
9	5
11 n 39 (odd harmonics only)	3

* *l* is the circuit power factor

4.8.2 If the lamp active input power 25 W, the harmonic currents shall not exceed the relative limits given in Table 2.

TABLE 2 - Harmonic current limits for lamps (active input power 25 W)

Harmonic Order n	**Maximum permissible harmonic current per watt mA/W**
(1)	**(2)**
3	3.4
5	1.9
7	1.0
9	0.5
11	0.35
13 n 39 (odd harmonics only)	3.85/n

4.9 Power factor

The power factor of the lamps shall be greater than 0.50 when tested in accordance with **6.4.5.**

5 MARKING

5.1 Lamps shall be marked with the following information.

a) Rated wattage
b) Rated voltage and frequency
c) Brand name of the manufacturer or responsible vendor.

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

In addition, any special conditions or restrictions which shall be observed for operating the lamp, **e.g**. dimming circuits, shall be marked on the lamp or the container or in installation instructions.

6 TESTS

6.1 Sampling

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.

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

6.2 General test conditions.

a) All tests shall be made in a draught-proof room at an ambient temperature maintained within 20°C to 30°C and a relative humidity of maximum 65%.

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

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

6.3 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 (Vapour Pressure Control) types, where the following procedure shall be carried out.

VPC lamps aged for a period of at least 100 h normal operation and then switched off for at least 24 h before the run-up test is 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% of the rated voltage or, in case of a voltage range, 92% of the minimum value of that range.

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

6.4 Electrical and photometric characteristics

6.4.1 *Test Environment*

6.4.1.1 Temperature

The temperature inside the integrating sphere shall be controlled within the range $25 \pm 1\ ^{o}C$.

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.

6.4.1.2 Vibration

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

6.4.2 ***Ageing***

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

6.4.3 ***Stabilization***

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

6.4.4. *Measuring equipment*

6.4.4.1 Electrical instruments

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

b) The impedance of an instrument which is connected in parallel to the lamp shall be sufficiently high so that the shunt current is not more than 0.1 % 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 more than 1% of the lamp voltage.

c) Any type of wave anlayzer may be used, for example, frequency-domain instrumentation using selective amplifier, heterodyne, multiple passive filters, spectrum analyser tuned to the frequency to be measured and time domain- instrumentation using digital filters or Discrete-Fourier Transform (DFT). The instrument may be of either the indicating or the recording type. The requirements specified in Appendix **B** ensure the equivalence of frequency domain and time domain instruments in a practical sense.

6.4.4.2 Photometric equipment

The photometric equipment 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.

6.4.5 Method of measurement

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

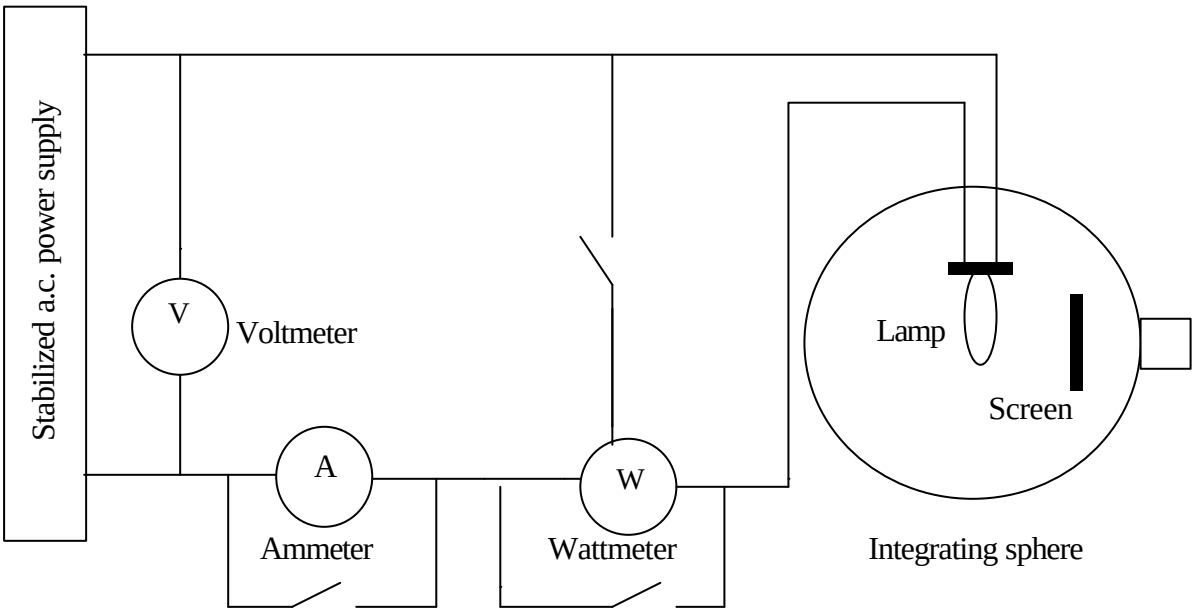


FIGURE 1 - Operating Circuit of Lamps for Testing

Photometric characteristics shall be measured in accordance with the recommendations of **CIE 84**.

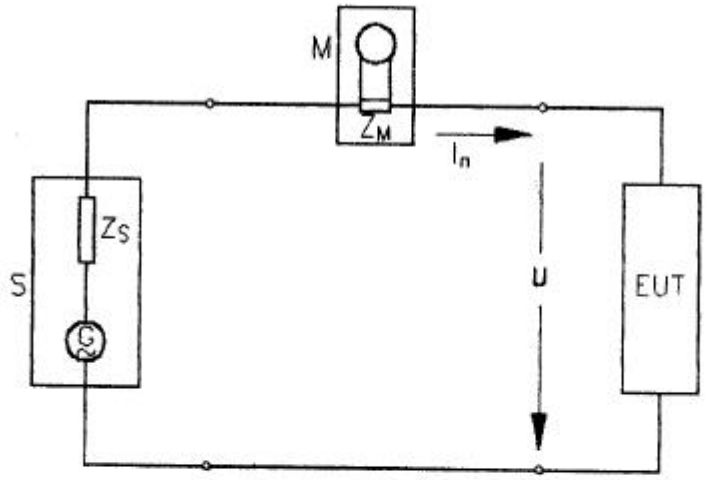
Total luminous flux shall be measured with an integrating sphere.

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.

6.5 Measurement of harmonic content

6.5.1 Test circuit

The measured harmonic values shall be compared with the limits given in **4.8**. The harmonic currents of the lamps shall be measured in accordance with the circuits given in Figure **2.**



S	Power supply source	Z_M	Input impedance of the saupply source
M	Measurement equipment	Z_S	Internal impedance of the supply source
EUT	Equipment under test	I_n	Harmonic component of order n of the line current
U	Test voltage	G	Open–loop voltage of the supply source

NOTES

1 Z_S and Z_M are not specified, but have to be sufficiently low to suit the test requirements. For the value of Z_M (see annex B.2.b).

2 In some special cases, particular care may be necessary to avoid resonance between the internal inductance of the source and the capacitances of the equipment under test.

FIGURE 2- Measurement circuit for single – phase equipment

6.5.2 *Supply Source*

While the measurements are being made, the test voltage (U) at the terminals of the lamp under test, when operated according to Appendix **B**, shall meet the following requirements.

a) The test voltage (U) shall be the rated voltage of the lamp. In case of a voltage range, the test voltage shall be 230 V. The test voltage shall be maintained within ± 2,0 % and the frequency within ± 0.5 % of the nominal value.

b) The harmonic ratio of the test voltage (U) shall not exceed the following values with the lamp connected as in normal operation :

0.9 % for harmonic of order 3;
0.4 % for harmonic of order 5
0.3 % for harmonic of order 7
0.2 % for harmonic of order 9
0.2 % for even harmonics of order from 2 to 10;
0.1 % for harmonics of order from 11 to 40.

c) The peak value of these test voltage shall be within 1.40 and 1.42 times its r.m.s value and shall be reached within 87^{o} to 93^{o} after the zero crossing.

6.6 Life test

6.6.1 ***Ambient***

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

6.6.2 ***Switching on and off***

Lamps on 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.

6.6.3 ***Method***

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

APPENDIX A
METHOD OF MEASURING LAMP CHARACTERISTICS

A.1 GENERAL

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

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 the 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). 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 Δx and Δy 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 coefficient are the basis for calculating è, a and b, where è is the angle between the major axis of the ellipse and the X axis and a and b are the major and minor semi axis of an ellipse of 1 SDCM.

A.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) :

TABLE 3 – Rated values of x and y for standardized chromaticity coordinates

"Colour"	T_c	X	Y
(1)	(2)	(3)	(4)
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

TABLE 4 – Values of coefficient of g_{11}, g_{12} and g_{22} for standardized chromaticity coordinates

"Colour"	g_{11}	g_{12}	g_{22}
(1)	(2)	(3)	(4)
F 6500	86×10^4	-40×10^4	45×10^4
F 5000	56×10^4	-25×10^4	28×10^4
F 4000	39.5×10^4	-21.5×10^4	26×10^4
F 3500	38×10^4	-20×10^4	25×10^4
F 3000	39×10^4	-19.5×10^4	27.5×10^4
F 2700	44×10^4	-18.6×10^4	27×10^4

TABLE 5 – Values of è, a and b for standardized chromaticity coordinates:

"Colour"	è	a	B
(1)	(2)	(3)	(4)
F 6500	$58^o\ 23'$	0.00223	0.00095
F 5000	$59^o\ 37'$	0.00274	0.00118
F 4000	$54^o\ 00'$	0.00313	0.00134
F 3500	$52^o\ 58'$	0.00317	0.00139
F 3000	$53^o\ 10'$	0.00278	0.00136
F 2700	$57^o\ 17'$	0.00258	0.00137

For an example the tolerance area is shown in Figure **3** for standard colour F 6500, together with the rated values, a part of the black body locus, and lines of constant correlated colour temperature.

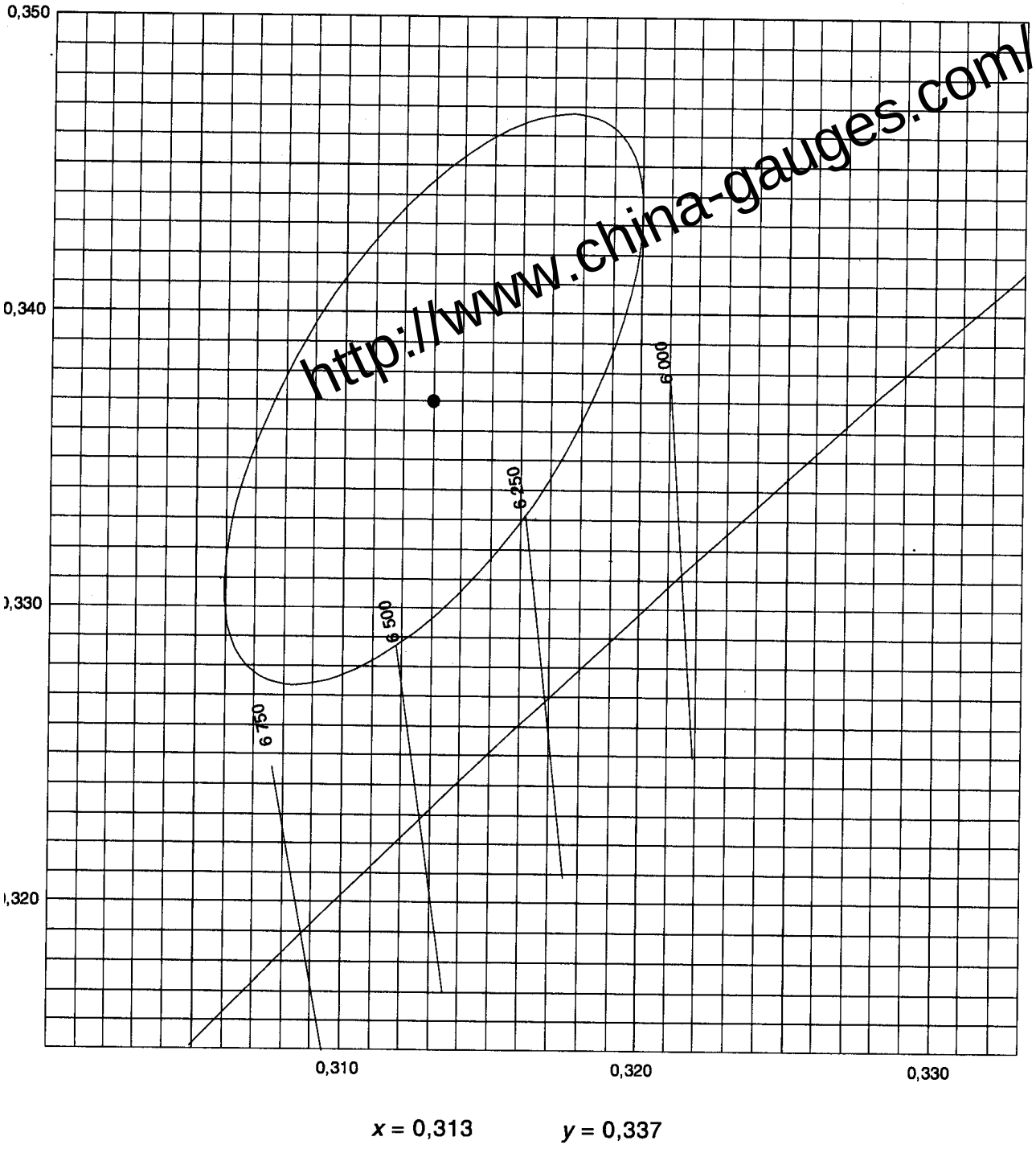


FIGURE 3 –Tolerance area for standard “colour” F 6500

APPENDIX B
REQUIREMENTS FOR MEASUREMENT EQUIPMENT

B.1 GENERAL

The following requirements ensure the equivalence of frequency-domain and time-domain instruments in a practical sense.

NOTES

1. In this standard, both time-domain and frequency-domain instruments are considered as equivalent. Neither of them is considered as the reference instrument. The use of a DFT-Instrument as a reference instrument is under consideration; It could have a rectangular window with a width of 16 cycles of the fundamental frequency of the power supply.

2. Further useful information is available in IEC Technical Report 1000-4.7

B.2 REQUIREMENTS COMMON TO ALL INSTRUMENTATION

a) The total error of the measurement equipment. M, in Figure **2** when measuring a steady-state harmonic component of the current shall not exceed 5% of the permissible limits or 0.2% of the rated current of the lamp under test whichever is greater. The accuracy may be checked by internal or external calibration.

b) The input impedance, Z_M, of the whole measurement equipment, M, in Figure **2** shall be such that the voltage drop due to the input current of the lamp under test does not exceed 0.15 V peak.

c) If the harmonic components of the measured current vary so as to potentially exceed the limit value during the test, they shall be evaluated by a procedure corresponding to a smoothing of the amplitudes according to a first order low-pass filter having a time constant of 1.5 s ± 10 %.

NOTES

1. When using an external shunt with a time constant not exceeding 10^{-5} s, the additional error due to the shunt can be considered to be negligible.

2. When using a current-transformer, It has to be ensured that possible d.c components of the measured currents do not increase the total error beyond the limits stated in B.2.a).

3) Care should be taken that the possible high crest factor (ratio of peak value to r.m.s. value) of the current or the high value of the fundamental current (supply frequency), as compared to the harmonic currents to be measured, do not produce overload or harmful Intermodulation error signals in the input stages of the instrument.

B.3 REQURIEMENTS FOR FREQUENCY-DOMAIN INSTRUMENTATION (STEADY STATE)

The selectivity of the instrument is determined for each value of f_n by the following requirements, f_n being the frequency of the harmonic of order n to be measured (for which the instrument is set) and f_1 the supply frequency (50 Hz.)

a) The minimum attenuation for an injected single harmonic frequency signal equal to $f_n - f_1$ or to $f_n + f_1$ is defined by the following values.

		Minimum attenuation in decibels
If $2 f_1 < f_n$	$12 f_1$,	30
If $12 f_1 < f_n$	$20 f_1$,	20
If $20 f_1 < f_n$	$40 f_1$,	15

b) Additionally, the attenuation shall be higher than or equal to 50 dB for any injected single harmonic frequency equal or lower than 0.5 f_n.

c) Additionally, the attenuation of the supply frequency f_1 (50 Hz) shall be at least 60 dB.

B.4 REQUIREMENTS FOR TIME-DOMAIN INSTRUMENTATION USING DISCRETE-FOURIER-TRANSFORM (DFT) - (STEADY STATE)

a) The width of the measuring window shall be between four cycles and 30 cycles of the fundamental frequency with an integer number of cycles.

b) The shape of the window is not specified.

However, if a rectangular window (Figure **4**) is chosen, it is necessary to synchronize the sampling rate with the fundamental frequency f_1 in such a way that the maximum relative deviation between f_1 and frequency $f_{syn,}$ to which the sampling rate is synchronized, is equal to or lower than 0.03 % f_1 under steady-state conditions.

When using a Hanning window (Figure **5**) such a strict synchronization may not be necessary.

a) There are no requirements for a gap and/or overlapping between successive windows.

b) Attenuation of anti-aliasing filters must be at least 50 dB for frequencies folded back into the measured frequency-band.

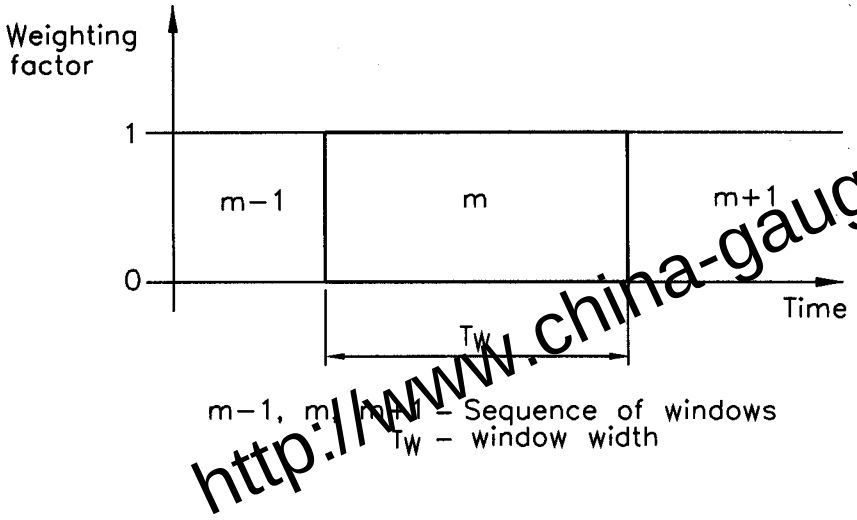


FIGURE 4 - Form and arrangement of rectangular time-windows

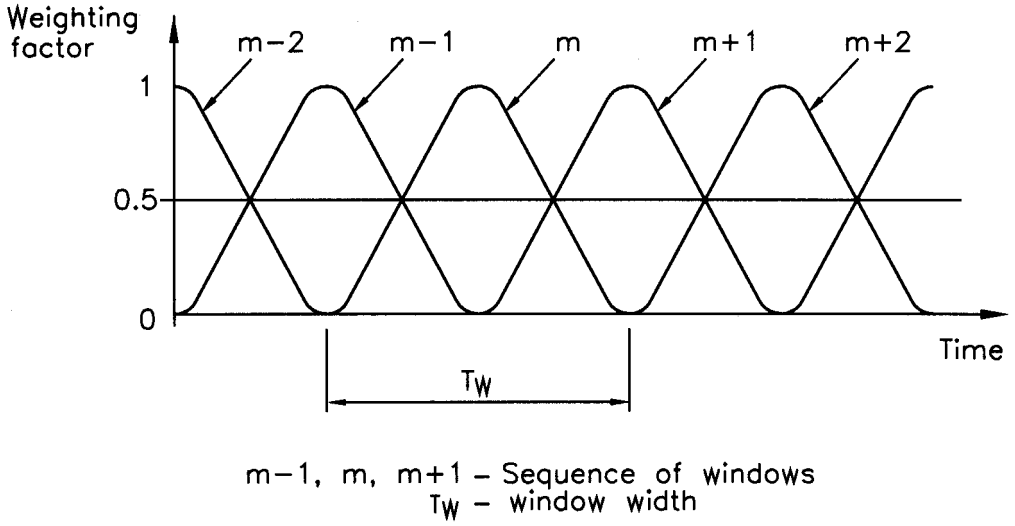


FIGURE 5 – Form and arrangement of hanning time-windows

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SRI LANKA STANDARDS INSTITUTION

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