SRI LANKA STANDARD 1232: 2003
UDC 621.327.534.15

SPECIFICATION FOR
SINGLE CAPPED COMPACT FLUORESCENT LAMPS
PART 1 – PERFORMANCE REQUIREMENTS

SRI LANKA STANDARDS INSTITUTION

SPECIFICITON FOR
SINGLE CAPPED COMPACT FLUORESCENT LAMPS
PART 1 - PERFORMANCE REQUIREMENTS

SLS 1232 : 2003

Gr. 20

Sri Lanka Standards Institution
No. 17, Victoria Place
Off Elvitigala Mawatha
Colombo 08
Sri Lanka.

Sri Lanka Standards are subject to periodical revision in order to accommodate the progress made by industry. Suggestions for improvement will be recorded and brought to the notice of the Committees to which the revisions are entrusted.

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

SRI LANKA STANDARD
SPECIFICITON FOR SINGLE CAPPED COMPACT FLUORESCENT 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 2003-01-14.

This standard is published 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 Single Capped fluorescent lamps. Part 2 of the Standard deals with safety requirements is a direct adoption of **IEC 1199. SLS 1231** deals with Compact fluorescent lamps of Self ballasted (Integral type) in two parts. Part 1 for Performance requirements and the other for safety.

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.

The Sri Lanka Standards Institution gratefully acknowledges the use of **IEC 60901:** 1996 of International Electrotechnical Commission, in the preparation of this standard.

1. SCOPE

This Sri Lanka Standard specifies the performance requirements and methods of test for single-capped fluorescent lamps for general lighting service.

The following lamp types and modes of operation with external ballasts are included :

a) lamps operated with an internal means of starting, having preheated cathodes, for operation on a.c mains frequencies;
b) lamps operated with an external means of starting, having preheated cathodes, for operation on a.c mains frequencies with the use of a starter, and additionally operating on high frequency;
c) lamps operated with an external means of starting, having preheated cathodes, for operation on a.c mains frequencies without the use of a starter (starterless) and additionally operating on high frequency;
d) lamps operated with an external means of starting, having preheated cathodes, for operation on high frequency;
e) lamps operated with an external means of starting, having non-preheated cathodes, for operation on high frequency.

2. REFERENCES

***CIE 84** Report on Measurement of Luminous flux
CS 102 Presentation of Numerical values
SLS 882 Glow starters for tubular fluorescent lamps
SLS 1150 Ballasts for tubular fluorescent lamps
Part 2 Performance requirements
SLS 1239 Electronic ballasts for fluorescent lamps

3. DEFINITIONS

For the purpose of this standard, the following definitions shall apply.

3.1 calibration current of a reference ballast: Value of the current on which the calibration and control of the reference ballast are based

3.2 compact fluorescent lamp : A fluorescent lamp which is shaped into a compact size by bending or connecting the glass tubes. These lamps may be with or without built in starter.

3.3 conditioning period : Time required after switching on a lamp to reach stabilization of the vapour pressure within the discharge tube.

3.4 fluorescent lamp : Discharge lamp of the low pressure mercury type, in which most of the light is emitted by one or several layers of phosphors excited by the ultraviolet radiation from the discharge.

3.5 initial readings : Starting characteristics of a lamp, measured before ageing, and the electrical, photometric and cathode characteristics of a lamp, measured at the end of the 100 h ageing period.
.
3.6 lumen maintenance : Ratio of the luminous flux of a lamp at a given time in its life to its initial luminous flux, the lamp being operated under specified conditions. This ratio is generally expressed as a percentage.

3.7 nominal value : Approximate quantity value used to designate or identify a lamp

3.8 rated value : Quantity value for a characteristic of a lamp for specified operating conditions. The value and the conditions are specified in this standard, or assigned by the manufacturer or responsible vendor.

3.9 reference ballast : Special ballast, either inductive for lamps for operation on a.c. mains frequencies, or resistive for a lamps for operation on high frequency. It is designed for the purpose of providing comparison standards for use in testing ballasts, for the selection of reference lamps and for testing regular production lamps under standardized conditions. It is essentially characterized by the fact that at its rated frequency, it has a stable voltage/current ratio which is relatively uninfluenced by variations in current, temperature and magnetic surroundings, as outlined in the relevant ballast standard.

* International Technical Commission on Illumination.

3.10 single – capped fluorescent lamp : Fluorescent lamp having a single cap, for operation on external circuits with either and internal or an external means of starting.

3.11 starting aid : Conductive strip affixed to the outer surface of a lamp, or a conductive plate which is spaced within an appropriate distance from the lamp. A starting aid is usually connected to earth potential, and can only be effective when it has an adequate potential difference from one end of the lamp.

3.12 type test : Test or a 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 type test.

4. REQUIREMENTS

4.1 Lamp data sheets

Types of single capped lamps, commonly used in Sri Lanka are given in Table**1**. Lamp data sheets for Dual and Quad shapes are given in Appendix **A.**

4.2 Diagrammatic data sheets

Diagrammatic data sheets locates dimensions given in the lamp data sheets.

4.3 Starting characteristics

A lamp shall start fully within the time specified on the relevant lamp data sheet and remain alight. Method of test and test conditions are given in **6.1.**

4.4 Electrical and cathode characteristics

a) The initial reading of the voltage at the lamp terminals shall comply with the values specified on the relevant lamp data sheet.
b) The initial reading of the power dissipated by a lamp shall not exceed the rated wattage, specified on the relevant lamp data sheet by more than 5% + 0.5 W

NOTE :

Cathode watts due to supplementary heating are not included in the rated lamp wattage unless otherwise stated on the lamp data sheet.

c) For a lamp having preheated cathodes for operation on a.c mains frequency starterless circuits, the initial reading of the resistance of each cathode shall be not less than the minimum value specified on the relevant lamp data sheet.
d) For a lamp having preheated cathodes for operation on high frequency, the initial reading of the resistance of each cathode shall comply with the values specified on the relevant lamp data sheet.

Methods of test and test conditions are given in **6.2.**

4.5 Photometric characteristics

a) The initial reading of the luminous flux of a lamp shall be not less than 90% of the rated value.

b) 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.

c) 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.

See rated colour characteristics in Appendix **B.**

4.6 Lumen maintenance

The lumen maintenance of a lamp, at any time in its life, shall be not less than 90% of the rated value. Method of test and test conditions are given in **6.3**

4.7 Radio interference suppression (RIS)

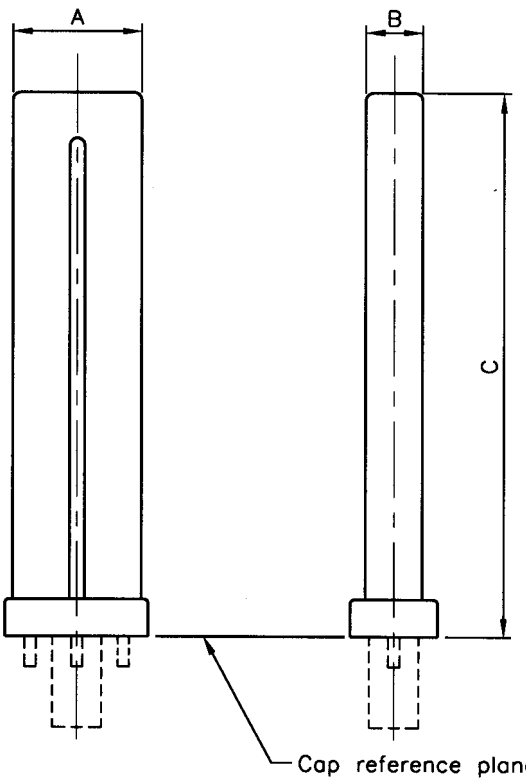
A lamp with an internal starter shall contain means to aid in the suppression of radio interference, the effect of which shall be equivalent to that of the RIS capacitor prescribed in Clause **6.11** of **SLS 882.**

TABLE 1 – Lamp data sheets

Nominal wattage W	Frequency Hz	Shape	Cap Type	Means of starting	Circuit		Cathode type
					AC Mains	High frequency	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
5	50	Dual	G23	Internal	--	--	Preheated
5	50	Dual	2G7	External	Starter	Starterless	Preheated
7	50	Dual	2G7	External	Starter	Starterless	Preheated
7	50	Dual	G23	Internal	--	--	Preheated
9	50	Dual	G23	Internal	--	--	Preheated
9	50	Dual	2G7	External	Starter	Starterless	Preheated
10	50	Quad	G24d-1	Internal	--	--	Preheated
10	50	!Quad	G24q-1	External	Starter	Starterless	Preheated
10	50	Square	GR 10q	External	Starterless	--	Preheated, high resistance
10	50	Square	GR 10q	External	Starter	--	Preheated
11	50	Dual	2G7	External	Starter	Starterless	Preheated
11	50	Dual	G23	Internal	--	--	Preheated
13	50	Quad	G24d-1	Internal	--	--	Preheated
13	50	Multilimbed	GX24d-1	Internal	--	--	Preheated
13	50	Quad	G24q-1	External	Starter	Starterless	Preheated
13	50	Quad	GX10q-2	External	Starter	--	Preheated
13	50	Multilimbed	GX24q-1	Extenral	Starter	Starterless	Preheated
16	50	Square	GR8	Internal	--	--	Preheated
16	50	Square	GR10q	External	Starter	--	Preheated
16	50	Square	GR10q	External	Starterless	--	Preheated, high resistance
18	50	Quad	G24d-2	Internal	--	--	Preheated
18	50	Multilimbed	GX24d-2	Internal	--	--	Preheated
18	50	Dual	2G11	External	Starter	Starterless	Preheated
18	50	Quad	G24q-2	External	Starter	Starterless	Preheated
18	50	Multilimbed	GX24q-2	External	Starter	Starterless	Preheated
18	50	Quad	GX10q-3	External	Starter	--	Preheated
18	50	Square	2G10	External	Starter	Starterless	Preheated
21	50	Square	GR10q	External	Starter	--	Preheated
21	50	Square	GR10q	External	Starterless	--	Preheated, high resistance

TABLE 1(Concluded)

Nominal wattage W	Frequency Hz	Shape	Cap Type	Means of starting	Circuit		Cathode type
					AC Mains	High frequency	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
22(D29)	50	Circular	G10q	Extrnal	Starter	Starterless	Preheated
24	50	Dual	2G11	External	Starter	Starterless	Preheated
24	50	Square	2G10	External	Starter	Starterless	Preheated
26	50	Quad	G24d-3	Internal	--	--	Preheated
26	50	Multilimbed	Gx24d-3	Internal	--	--	Preheated
26	50	Quad	GX24q-3	External	Starter	Starterless	Preheated
26	50	Multilimbed	GX24q-3	External	Starter	Starterless	Preheated
27	50	Dual	GY10q-4	External	Starter	--	Preheated
27	50	Quad	GX10q-4	External	Starter	--	Preheated
28	50	Square	GR8	Internal	--	--	Preheated
28	50	Dual	GY10q-5	External	Starter	--	Preheated
28	50	Square	GR10q	External	Starter	--	Preheated
28	50	Square	GR10q	External	Starterless	--	Preheated, low resistanc
30	50	Dual	GY10q-4	External	Starter	--	Preheated
32(D29)	50	Circular	G10q	External	Starter	Starterless	Preheated
32(D32)	50	Circular	G10q	External	Starter	Starterless	Preheated
32	20K	Multilimbed	GX24q-3	External	--	Starterless	Preheated
36	50	Dual	GY10q-6	External	Starter	--	Preheated
36	50	Dual	2G11	External	Starter	Starterless	Preheated
36	50	Square	2G10	External	Starter	Starterless	Preheated
38	50	Square	GR10q	External	Starter	--	Preheated
38	50	Square	GR10q	External	Starterless	--	Preheated, low resistanc
40 (D29)	50	Circular	G10q	External	Starter	Starterless	Preheated
40(D32)	50	Circular	G10q	External	Starter	Starterless	Preheated
40	20 K	Dual	2G11	External	--	Starterless	Preheated
40	20 K	Dual	2G11	External	--	Starterless	Non-Preheated
42	20K	Multilimbed	GX24q-4	External	--	Starterless	Preheated
55	20K	Dual	2G11	External	--	Starterless	Preheated

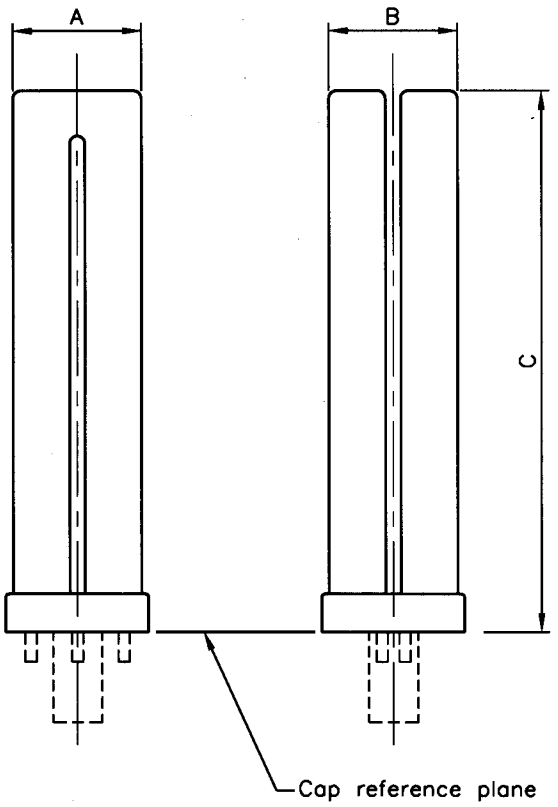


NOTE : *Dimensions A and B refer to the glass parts of the lamp*

FIGURE 1 - Diagrammatic data sheet for location of lamp dimensions for dual-shaped

TABLE 2 - Types of Dual shaped lamps

Nominal wattage W	Frequency Hz	Cap Type	Means of starting	Circuit		Cathode type
				AC Mains	High frequency	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
5	50	G23	Internal	-	-	Preheated
7	50	G23	Internal	-	-	Preheated
9	50	G23	Internal	-	-	Preheated
11	50	G23	Internal	-	-	Preheated
5	50	2G7	External	Starter	Starterless	Preheated
7	50	2G7	External	Starter	Starterless	Preheated
9	50	2G7	External	Starter	Starterless	Preheated
11	50	2G7	External	Starter	Starterless	Preheated
18	50	2G11	External	Starter	Starterless	Preheated
24	50	2G11	External	Starter	Starterless	Preheated
27	50	GY10q-4	External	Starter	-	Preheated
28	50	GY10q-5	External	Starter	-	Preheated
30	50	GY10q-4	Externa	Starter	-	Preheated
36	50	GY10q-6	External	Starter	-	Preheated
36	50	2G11	External	starter	Starterless	Preheated
40	20K	2G11	External	-	Starterless	Preheated
40	20K	2G11	External	-	Starterless	Non-Preheated



NOTE : *Dimensions A and B refer to the glass parts of the lamp*

FIGURE 2 - Diagrammatic data sheet for location of lamp dimensions for quad-shaped

TABLE 3 -Types of Quad shaped lamps

Nominal wattage W	Frequency Hz	Cap Type	Means of starting	Circuit		Cathode type
				AC Mains	High frequency	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
10	50	G24d-1	Internal	-	-	Preheated
13	50	G24d-1	Internal	-	-	Preheated
18	50	G24d-2	Internal	-	-	Preheated
26	50	G24d-3	Internal	-	-	Preheated
10	50	G24q-1	External	Starter	Starterless	Preheated
13	50	G24q-1	External	Starter	Starterless	Preheated
18	50	G24q-2	External	Starter	Starterless	Preheated
26	50	G24q-3	External	Starter	Starterless	Preheated
13	50	GX10q-2	External	Starter	-	Preheated
18	50	GX10q-3	External	Starter	-	Preheated
27	50	GX10q-4	External	Starter	-	Preheated

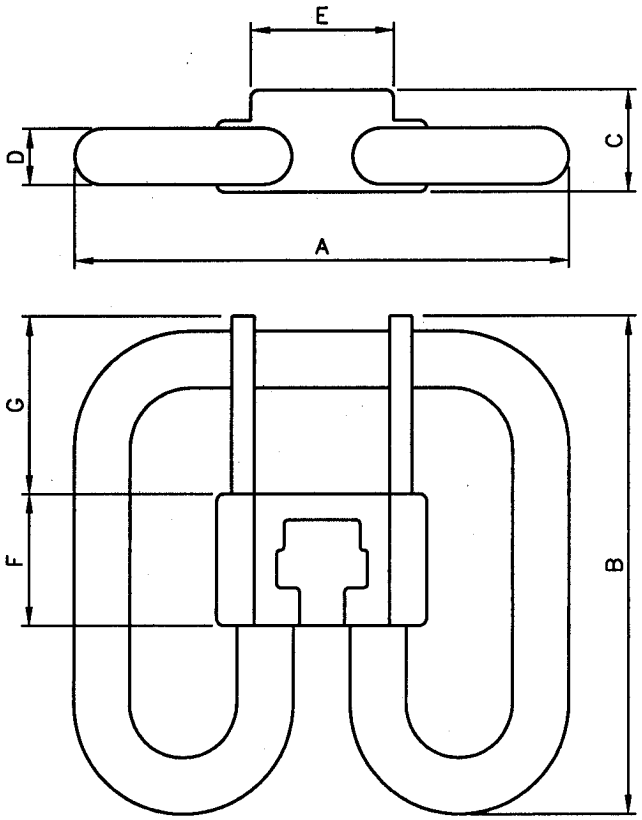


FIGURE 3 - Diagrammatic data sheet for location of lamp dimensions for square-shaped

TABLE 4 - Types of Square shaped lamps

Nominal wattage W	Frequency Hz	Cap Type	Means of starting	Circuit		Cathode type
				AC Mains	Frequency	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
10	50	GR10q	External	Starter	-	Preheated
16	50	GR10q	External	Starter	-	Preheated
18	50	2G10	External	Starter	Starterless	Preheated
24	50	2G10	External	Starter	Starterless	Preheated
36	50	2G10	External	Starter	Starterless	Preheated
10	50	GR10q	External	Starterless	-	Preheated, high
16	50	GR10q	External	Starterless	-	.resistance
21	50	GR10q	External	Starterless	-	Preheated ,high.
21	50	GR10q	External	Starterless	-	resistance
28	50	GR10q	External	Starterless	-	Preheated, high
28	50	GR10q	External	Starter	-	.resistance
38	50	GR10q	External	Starter	-	Preheated
38	50	GR10q	External	Starterless	-	Preheated, low .resistance
						Preheated
						Preheated
						Preheated, low .resistance
16	50	GR8	Internal	-	-	Preheated
28	50	GR8	Internal	-	-	Preheated

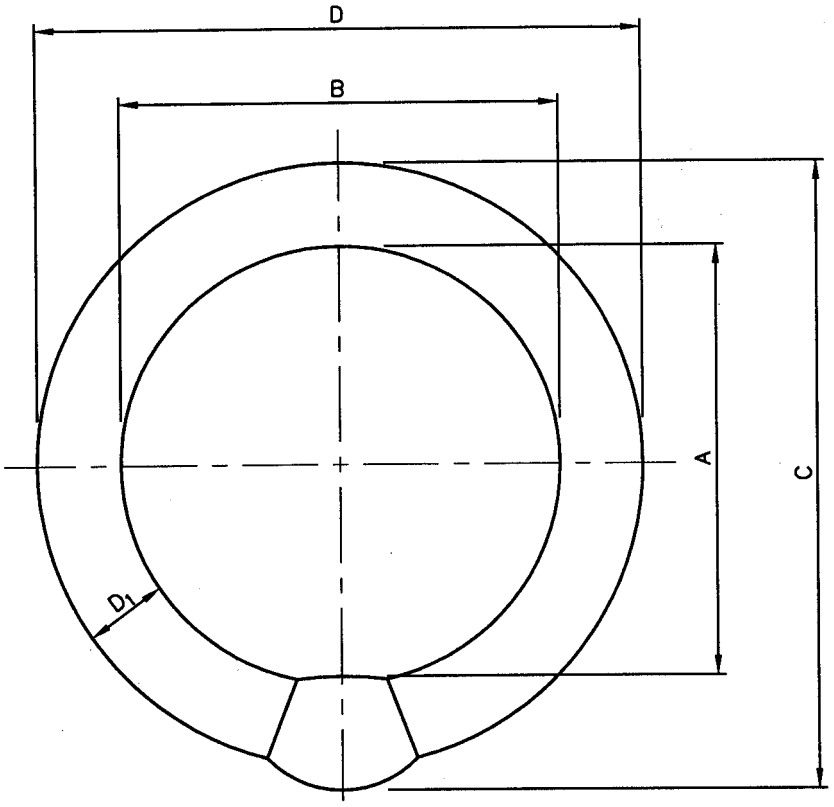
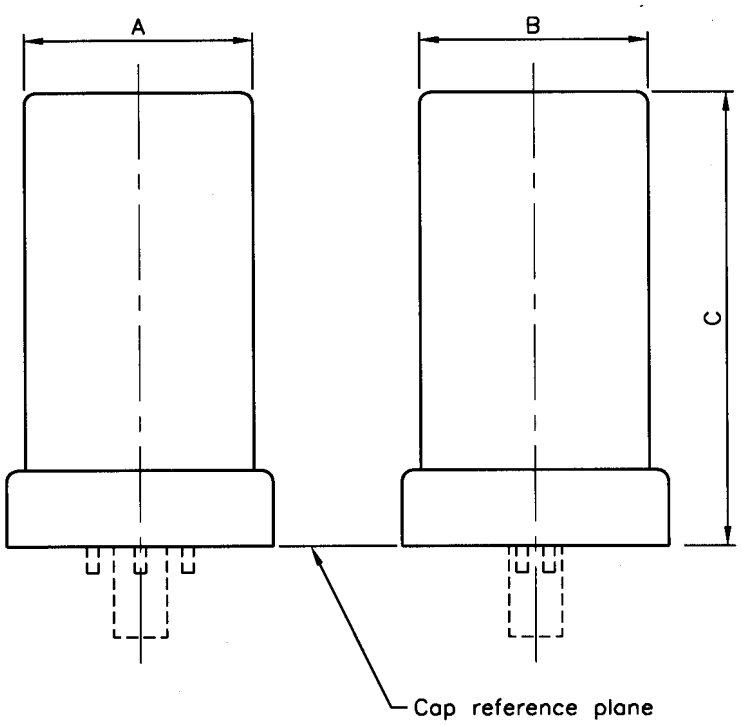


FIGURE 4 - Diagrammatic data sheet for location of lamp dimensions for circular-shaped

TABLE 5 -Types of Circular shaped lamps

Nominal wattage W	Frequency Hz	Cap Type	Means of starting	Circuit		Cathode type
				AC Mains	Frequency	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
22 (D29)	50	G10q	External	Starter	Starterless	Preheated
32 (D29)	50	G10q	External	Starter	Starterless	Preheated
32(D32)	50	G10q	External	Starter	Starterless	Preheated
40 (D29)	50	G10q	External	Starter	Starterless	Preheated
40(D32)	50	G10q	External	Starter	Starterless	Preheated



NOTE : *Dimensions A and B refer to the glass parts of the lamp*

FIGURE 5 - Diagrammatic data sheet for location of lamp dimensions for multi-limbed

TABLE 6 - Types of Multi –limbed shaped lamps

Nominal wattage W	Frequency Hz	Cap Type	Means of starting	Circuit		Cathode type
				AC Mains	Frequency	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
13	50	GX24d-1	Internal	-	-	Preheated
18	50	GX24d-2	Internal	-	-	Preheated
26	50	GX24d-3	Internal	-	-	Preheated
13	50	GX24q-1	External	Starter	Starterless	Preheated
18	50	GX24q-2	External	Starter	Starterless	Preheated
26	50	GX24q-3	External	Starter	Starterless	Preheated
32	20K	GX24q-3	External	-	Starterless	Preheated
42	20K	GX24q-4	External	-	Starterless	Preheated

5. MARKING

5.1 Lamps shall be marked with the following information.

a) Rated wattage.
b) Rated voltage and frequency
c) Brand name

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

5.3 A further identification which defines, with the aid of information made available by the manufacturer or responsible vendor, the electrical and photometric characteristics of a lamp.

NOTE

If necessary for proper identification, additional information should be included (for example the nominal tube diameter in millimetres).

6 TESTS

6.1 Methods of test for starting characteristics

6.1.1 *General*

Tests shall be made in a draught-free atmosphere at an ambient temperature in the range of 20 ^{o} C to 27 ^{o} C and a relative humidity of 65% maximum.

Electrical and Photometric tests should be carried out using an Integrating sphere.

Metallic parts and wires in the vicinity of the lamp, except starting aids when required, shall be avoided as far as possible.

Immediately prior to the starting test the lamps shall be kept inoperative in an ambient temperature in the range of 20 ^{o} C and 27 ^{o} C and a relative humidity of 65 % maximum for a period of at least 24 h.

6.1.2 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.

6.1.3 Method of measurement

The test circuit for photometric and electrical measurements is shown in Figure **6.**

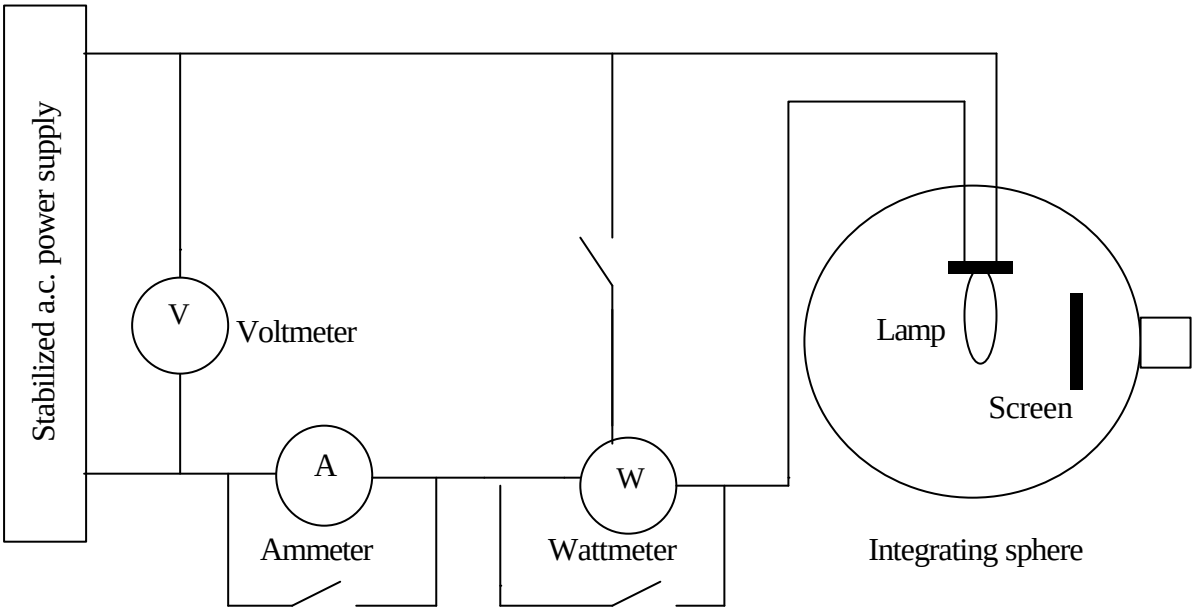


FIGURE 6 - Operating Circuit of Lamps for Testing

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.

6.1.4 Lamps having preheated cathodes for operation on a.c. mains frequencies with an internal or external starter.

6.1.4.1 Test circuit

Lamps shall be tested with a 50 Hz supply in the circuits shown in Figure **7** and, Figure **8.**

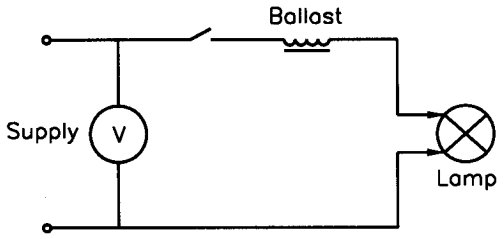


FIGURE 7 – Circuit diagram for starting test for lamps with internal starter

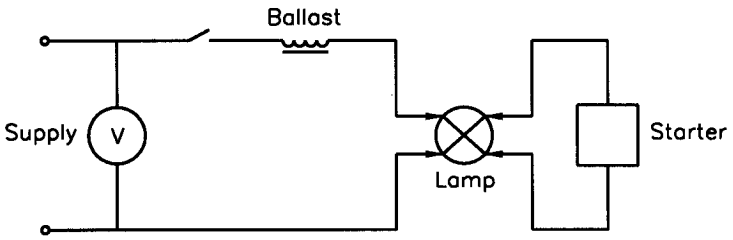


FIGURE 8 – Circuit diagram for starting test for lamps with external starter

6.1.4.2 Ballast

The ballast used shall comply with the requirements of **SLS 1150.** It shall be rated as specified on the relevant lamp data sheet.

When the ballast, at its rated voltage, is associated with a test lamp, the lamp shall dissipate a power which does not differ from its rated value by more than 4%. A test lamp is a lamp whose voltage at lamp terminals does not deviate by more than 2% from its rated value, when operated with its reference ballast.

The preheating current, when measured at 90% of rated ballast voltage, shall be between 1.1 and 1.2 times the rated lamp current. To obtain a value of the preheating current within this range , it may be necessary either to make a special selection from among commercial ballasts, or else to design and manufacture a ballast for this specific purpose.

In some cases, it may be possible to bring the preheating current down to be within this range by adding resistance in series with the starter.

NOTE

In some cases the ballast may include an autotransformer to increase (or reduce) the voltage to the proper value for the starting and operation of the lamp. Ballasts incorporating step-up transformers are particularly likely to be used in countries where 120 V or 100 V power systems predominate.

6.1.4.3 Starter

For lamps operated with an external starter, the type of glow starter to be used shall comply with the requirements of **SLS 882** and shall in any case be subject to agreement with the lamp manufacturer or responsible vendor.

6.1.4.4 Test voltage

The test voltage applied to the circuit shall be as specified on the relevant lamp data sheet.

6.1.5 *Lamps having preheated cathodes for operation on a.c. mains supply starterless circuits.*

6.1.5.1 Test circuit

Lamps shall be tested with a 50 Hz supply in the circuit shown in Figure **9.**

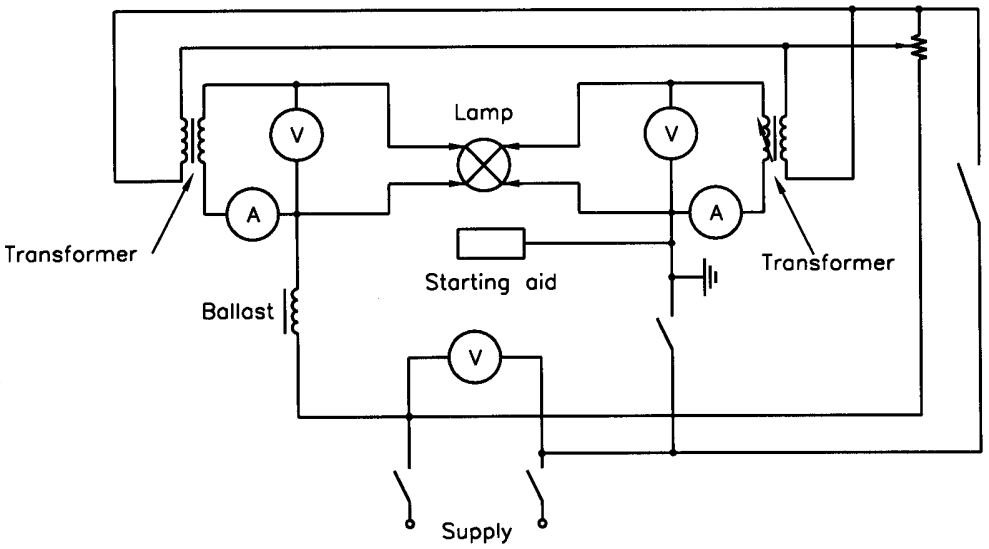


FIGURE 9 – Circuit diagram for starting test for lamps with preheated cathodes for operation on starterless circuits

6.1.5.2 Ballast

The ballast used shall comply with the requirements of **SLS 1150**. It shall be rated as specified on the relevant lamp data sheet.

When the ballast, at its rated voltage, is associated with a test lamp, the lamp shall dissipate a power which does not differ from its rated value by more than 4%. A test lamp is a lamp whose voltage at lamp terminals does not deviate by more than 2% from its rated value, when operated with its reference ballast.

NOTES

1 *In some cases the ballast may include an autotransformer to increase(or reduce) the voltage to the proper value for the starting and operating of the lamp. Ballasts incorporating step-up transformers are particularly likely to be used in countries where 120 V or 100 V power systems predominate.*

2 *The earthing of the circuit as shown in Figure .3 may make it necessary to supply it through an isolating transformer.*

6.1.5.3 Starting aid

The starting aid, a metal plate, shall be connected to earth potential. Its dimensions shall be not less than the dimensions specified for the maximum lamp outlines of the relevant lamp. The distance between the surface of the lamp and the starting aid shall be as specified on the relevant lamp data sheet.

The manufacturer or responsible vendor shall specify whether or not the lamps require an external starting aid. For lamps not requiring a separate starting aid, the metal plate shall be removed.

6.1.5.4 Test voltage

The voltage of the heating circuit to be applied to the cathode terminals and the open circuit voltage at the lamp terminals for the starting test shall be as specified on the relevant lamp data sheet.

NOTE

The voltages specified for the starting test are chosen primarily to secure reproducibility of test results, and are not necessarily applicable to the design of ballasts.

The voltages of the main circuit and of the heating circuits shall be applied simultaneously.

The voltage applied to the cathode heating circuits shall not be so connected as to increase the voltage of the main circuit. The two circuits shall be connected in the same phase.

The two cathode heating transformers may be replaced by one isolated secondary windings. The ratings of the transformer(s) shall be such that the voltage does not change by more than 2% when the maximum cathode load is connected.

If the lamp does not start at the specified open circuit voltage, this voltage shall be gradually increased up to a maximum of 110% of the test value. If the lamp still does not start, it shall be rejected. If the lamp does start, it shall be operated for half an hour at rated voltage and the normal test shall be made again after a rest period of 24 h.

6.1.5.5 Lamps for operation on high frequency

Lamps shall be tested with an a.c supply with a frequency between 20 kHz and 26 kHz in the circuits shown in Figure **10** and Figure **11**.

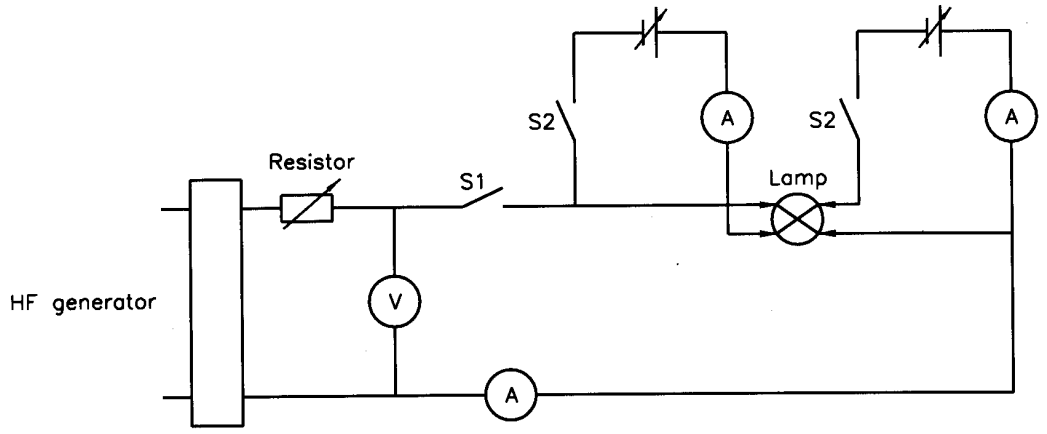


FIGURE 10 – Circuit diagram for starting test for lamps with preheated cathodes for operating on high frequency

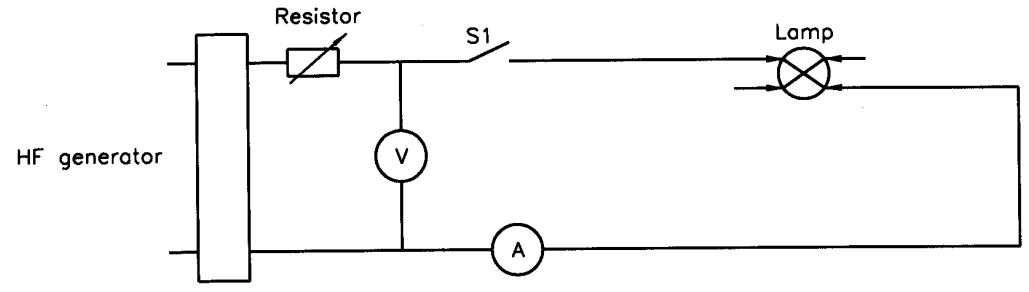


FIGURE 11 – Circuit diagram for starting test for lamps with non-preheated cathodes for operating on high frequency

The non-inductive ballast resistor shall be so adjusted that the high-frequency lamp current is equal to the value as specified on the relevant lamp data sheet.

The open circuit voltage applied at the circuit shall be as specified on the relevant lamp data sheet.

A starting aid shall not be used, unless otherwise stated on the relevant lamp data sheet, or by the manufacturer or responsible vendor.

For lamps with preheated cathodes, the cathode heating supplies shall be adjusted to supply a preheat current as specified on the relevant lamp data sheet. During the preheat time, specified on the relevant lamp data sheet, switch S_1 shall be kept open and switches S_2 closed. After this period of time, switches S_2 shall be opened simultaneously as switch S_1 is closed.

6.2 Method of test for electrical, photometric and cathode characteristics

6.2.1 Electrical and photometric characteristics

6.2.1.1 General

Photometric characteristics shall be measured in accordance with the relevant recommendations of the (CIE (Commission International de 1'Eclairage).

Before the lamps are measured for the first time, they shall be aged for a period of 100 h of normal operation.

Lamps shall be tested in a draught-free atmosphere at an ambient temperature of 25 ^{o}C ± 1 ^{o}C, unless otherwise specified on the relevant lamp data sheet.

Lamps shall be tested in the position as specified on the relevant lamp data sheet.

For lamps with external means of starting, the connections of the lamp contacts, with reference at the terminals of the ballast, shall not be changed of the whole course for the tests.

Measurements shall be made after a sufficient period of stabilization of the lamp. An appropriate stabilization time is 15 minutes, after the conditioning period as declared by the manufacturer or responsible vendor.

NOTE

During the shipping and normal handling of the lamps, any excess amount of mercury may be distributed in small droplets within the discharge tube. Stabilization is reached when all the excess mercury has been collected at the coldest spot in the tube. Experience has shown that initially this process of collecting may take up to 15 h. When a lamp, once having passed this conditioning period, is re-lit within 24 h, it will only need about 15 min for stabilizing, provided that the lamp has been kept in the same position and not subjected to vibration or shock.

6.2.1.2 Test circuit

Lamps shall be tested in the circuits shown in Figure **12**, Figure **13** and Figure **14**.

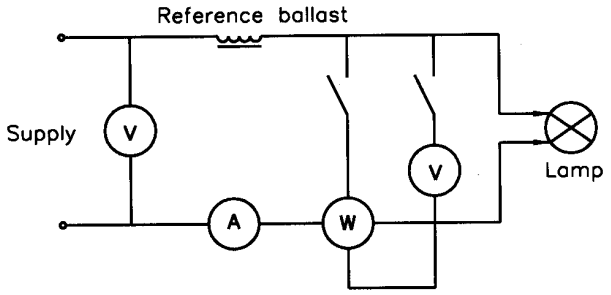


FIGURE 12 – Circuit diagram for measurement of electrical and photometric characteristics for lamps with internal starter

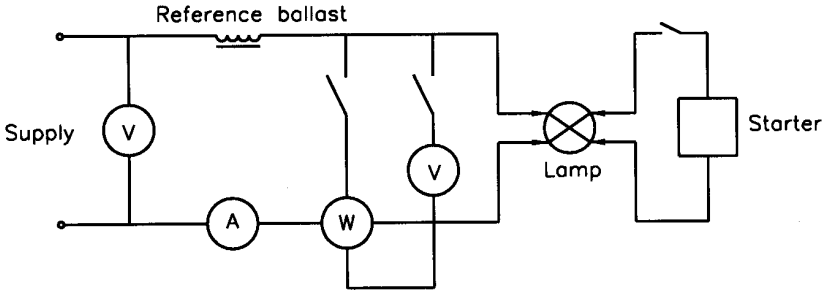


FIGURE 13 – Circuit diagram for measurement of electrical and photometric characteristics for lamps with external starter

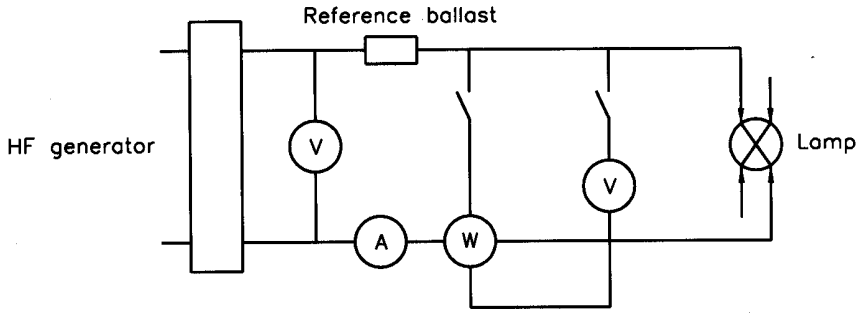


FIGURE 14 – Circuit diagram for measurement of electrical and photometric characteristics for lamps for operation on high frequency

In the test circuit for lamps for operation on high frequency, given in Figure **14** connections shall be as short and straight as possible to avoid parasitic capacitance. The parasitic capacitance parallel to the lamp shall be less than 1 nF.

6.2.1.3 Ballast

Ballasts used for these tests shall be reference ballasts as specified in **SLS 1150** for a.c mains frequencies, or **SLS 1239** for high frequency. The reference ballast electrical characteristics shall be as specified on the relevant lamp data sheet.

6.2.1.4 Supply voltage

The supply voltage shall be equal to the rated voltage of the reference ballast. During periods of stabilization, the supply voltage shall be stable within ± 0.5%, this tolerance being reduced to 0.2 % during measurement.

For a.c mains supplies, the frequency shall be equal to the rated frequency of the reference ballast with a tolerance of 0.5%. For high-frequency supplies, the frequency shall be between 20 kHz and 26 kHz.

The wave shape of the supply voltage shall be a sine wave. The total harmonic content shall not exceed 3% (for high-frequency supplies this value is under consideration). The total harmonic content is defined as the root-mean-square (r.m.s) summation of the individual harmonic components, using the fundamental as 100%.

NOTE

This implies that the source of supply should have sufficient power, and that the supply circuit should have a sufficiently low impedance, compared with the ballast impedance. Care should be taken that this applies under all conditions that occur during the measurement.

6.2.1.5 Electrical instruments

Instruments shall be of the true r.m.s. type, essentially free form waveform errors and suitable for the frequency of operation.

The voltage measuring circuit of the instruments shall have an impedance not less than 100 000 Ù , and shall be disconnected when not in use. The current measuring circuit of the instruments shall have the lowest possible resistance and, if necessary , shall be short circuited when not in use.

When measuring the lamp wattage, no correction shall be made for the wattmeter consumption (the circuit connection being mad on the lamp side of the current measuring circuit).

When measuring the luminous flux, the voltage measuring circuit of the voltmeter and of the wattmeter shall be open.

6.2.2 *Cathode characteristics of lamps having preheated cathodes for operation on starterless circuits*

6.2.2.1 Test circuit

Cathode resistance shall be measured using a suitable d.c supply or a 50 Hz a.c supply.

6.2.2.2 Lamps for operation on a.c mains frequencies

The voltage at the cathode terminals shall be adjusted to the value of the test voltage given on the relevant lamp data sheet, and the current shall be measured. From these, after deduction of the consumption of the voltmeter, the cathode resistance shall be determined.

6.2.2.3 Lamps for operation on high frequency

The current flowing through the cathode shall be adjusted to the value of the test current given on the relevant lamp data sheet, and the supply voltage shall be measured. From these, after deduction of the voltage across the ammeter, the cathode resistance shall be determined.

6.3 Method of test for lumen maintenance and life

6.3.1 *General Condition*

The luminous flux at a given time in the life of a lamp shall be measured as specified in **6.2.**

During the life testing lamps shall be operated as follows

Lamps shall be operated at an ambient temperature of between 15 ^{o}C and 50 ^{o}C. Excessive draughts shall be avoided and the lamps shall not be subject to extreme vibration and shock.

Lamps shall be operated in the test position as specified on the relevant lamp data sheet.

For lamps with external means of starting, the connections of the lamp contacts, with reference to the terminations of the ballast, shall not be charged for the whole course of the tests.

Lamps shall be operated in the circuit for which they are intended by the manufacturer.

The test voltage and frequency shall be equal to the rated voltage and frequency of the ballast.

Lamps shall be switched off for 15 min after each 2 h and 45 minutes of operation.

6.3.2 *Lamps for operation on a.c mains frequencies*

The ballast used shall comply with the requirements of **SLS 1150**.

When the ballast, at its rated voltage, is associated with a test lamp, the lamp shall dissipate a power which does not differ from its rated value by more than 4%. A test lamp is a lamp whose voltage at lamp terminals does not deviate by more than 2% from its rated value, when operated with its reference ballast.

NOTE

The choice of the type of ballasts for these tests is left upon, but the type used may have an influence on the results of the test. It is recommended that the type of ballast employed should be stated. In case of doubt, the use of an inductive type of ballast is recommended, because such a type has the smallest number of parameters capable of affecting the results.

For lamps operated switch an internal or external starter, the preheating current , at rated supply voltage, shall not differ by more than 10% from the rated value specified on the relevant lamp data sheet.

For lamps operated with an external starter, the type of starter to be used shall comply with the requirements of **SLS 882** and shall in any case be subjected to agreement with the lamp manufacturer or responsible vendor.

6.3.3 *Lamps for operation on high frequency*

The ballast used shall comply with the requirements of **SLS 1239**

APPENDIX A
DETAILED LAMP DATA SHEETS FOR SINGLE-CAPPED COMPACT FUORESCENT LAMPS

FOR 5 W DUAL SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
5 W	Internal starter	Preheated	G23

Dimensions (mm)		
A Max.	B Max.	C Max.
28	13	85

Starting characteristics			
Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	220 V	198 V	10 s

Electrical characteristics						
Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	5.4 W	35 V	30 V	40 V	0.180 A	0.190 A
Test position: vertical, cap-up						

Reference ballast characteristics					
Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	9 W	220 V	0.170 A	1180	0.12

Information for ballast design			
Frequency	Hz		50
Preheat cathode current	A	Min.	0.153
		Max.	0.240
Open circuit voltage across lamp	V	Min.(r.m.s)	198
		Max. (peak)	400
Substitution resistor for both cathodes in series			160
Lamp operating current	A	Max.	0.190

FOR 7 W DUAL SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
7 W	Internal starter	Preheated	G23

Dimensions (mm)		
A Max.	B Max.	C Max.
28	13	115

Starting characteristics			
Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	220 V	198 V	10 s

Electrical characteristics						
Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	7.1 W	47 V	42 V	52 V	0.175V	0.190V
Test position: vertical, cap-up						

Reference ballast characteristics					
Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	9 W	220 V	0.170 A	1.180	0.12

Information for ballast design			
Frequency	Hz		50
Preheat cathode current	A	Min.	0.153
		Max.	0.240
Open circuit voltage across lamp	V	Min.(r.m.s)	198
		Max. (peak)	400
Substitution resistor for both cathodes in series			160
Lamp operating current	A	Max.	0.190

FOR 9 W DUAL SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
9 W	Internal starter	Preheated	G23

Dimensions (mm)		
A Max.	B Max.	C Max.
28	13	145

Starting characteristics			
Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	220 V	198 V	10 s

Electrical characteristics						
Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	8.7 W	60 V	54 V	66 V	0.170 A	0.190 A
Test position: vertical, cap-up						

Reference ballast characteristics					
Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	9 W	220 V	0.170 A	1.180	0.12

Information for ballast design			
Frequency	Hz		50
Preheat cathode current	A	Min.	0.153
		Max.	0.240
Open circuit voltage across lamp	V	Min.(r.mr.s)	198
		Max. (peak)	400
Substitution resistor for both cathodes in series			160
Lamp operating current	A	Max.	0.190

FOR 11 W DUAL SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
11 W	Internal starter	Preheated	G23

Dimensions (mm)		
A	B	C
Max.	Max.	Max.
28	13	215

Starting characteristics			
Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	220 V	198 V	10 s

Electrical characteristics						
Frequency	Rated wattage	Voltage (r.m.s.) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	11.8 W	91 V	81 V	101 V	0.155 A	0.190 A
Test position: vertical, cap-up						

Reference ballast characteristics					
Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	9 W	220 V	0.170 A	1180 Ù	0.12

Information for ballast design		
Frequency Hz		50
Preheat cathode current	Min.	0.153
	Max.	0.240
Open circuit voltage across lamp V	Min.(r.m.s.)	198
	Max.(peak)	400
Substitution resistor for both cathodes in series Ù		160
Lamp operating current A	Max.	0.190

FOR 5 W DUAL SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
5 W	External starter	Preheated	2G7

Dimensions (mm)		
A Max.	B Max.	C Max.
28	13	85

Starting characteristics			
Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	220 V	198 V	10 s

Electrical characteristics						
Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	5.4 W	35 V	30 V	40 V	0.180 A	0.190 A
Test position: vertical, cap-up						

Reference ballast characteristics					
Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	9 W	220 V	0.170A	1180	0.12

Information for ballast design			
Frequency	Hz		50
Preheat cathode current	A	Min.	0.153
		Max.	0.240
Open circuit voltage across starter	V	Min.(r.mr.s)	198
Open circuit voltage across lamp	V	Max. (peak)	400
Substitution resistor for both cathodes in series			160
Voltage across starter with lamp operating	V	Max.(r.m.s)	*
Lamp operating current	A	Max.	0.190

* Under consideration

TABLE (Concluded)

Information for starter design			
Pulse voltage	Non-reclosure voltage	RIS capacitor	
Min.	Max.	Min.	Max.
* V	* V	* nF	* nF

Information for high-frequency ballast design			
Typical lamp characteristics			
Frequency	Lamp wattage	Lamp voltage	Lamp current
20 KHz	5 W	27 V	0.190 A

Current in any lead to cathodes	A	Max.	0.240
Lamp operating current	A	Min.	0.120
		Max.	0.190

Current controlled preheating			
Minimum preheat current i_k (A) emission time t_e (s) $i_k = (a/t_e + i_m^2)^{0.5}$		a	0.025
		i_m(A)	0.135
Maximum preheat current A		t 0.4	0.400
		0.4 <t < 2.0	0.430 – 0 . 090t
		t 2.0	0.250
Open circuit voltage across lamp (without starting aid) V	t t_e	Max.(r.m.s)	120
	t>t_e	Min.(r.m.s)	250
Substitution resistor for each cathode		Ù	50

Voltage controlled preheating
*

* Under consideration

FOR 7 W DUAL SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
7 W	External starter	Preheated	2G7

Dimensions (mm)		
A Max.	B Max.	C Max.
28	13	115

Starting characteristics			
Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	220 V	198 V	10 s

Electrical characteristics						
Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	7.1 W	47 V	42 V	52 V	0.175 A	0.190A
Test position: vertical, cap-up						

Reference ballast characteristics					
Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	9 W	220 V	0.170 A	1.180	0.12

Information for ballast design			
Frequency	Hz		50
Preheat cathode current	A	Min.	0.153
		Max.	0.240
Open circuit voltage across starter	V	Min.(r.m.s)	198
Open circuit voltage across lamp	V	Max. (peak)	400
Substitution resistor for both cathodes in series			160
Voltage across starter with lamp operating	V	Max.(r.m.s)	*
Lamp operating current	A	Max.	0.190

* Under consideration

TABLE (Concluded)

Information for starter design			
Pulse voltage Min.	Non-reclosure voltage Max.	RIS capacitor Min.	Max.
* V	* V	* nF	* nF

Information for high-frequency ballast design			
Typical lamp characteristics			
Frequency KHz	Lamp wattage W	Lamp voltage V	Lamp current A
20	6.5	37	0.175

Current in any lead to cathodes	A	Max.	0.240
Lamp operating current	A	Min.	0.120
		Max.	0.190

Current controlled preheating			
Minimum preheat current i_k (A) emission time t_e (s) $i_k = (a/t_e + i_m^2)^{0.5}$		a	0.025
		i_m(A)	0.135
Maximum preheat current	A	t 0.4	0.400
		0.4 <t < 2.0	0.430 - 0.090t
		t 2.0	0.250
Open circuit voltage across lamp (without starting aid)	V t t_e t>t_e	Max.(r.m.s) Min.(r.m.s)	130 270
Substitution resistor for each cathode		Ù	50
Voltage controlled preheating			
*			

* Under consideration

FOR 9 W DUAL SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
9 W	External starter	Preheated	2G7

Dimensions (mm)		
A Max.	B Max.	C Max.
28	13	145

Starting characteristics			
Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	220 V	198 V	10 s

Electrical characteristics						
Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	8.7 W	60 V	54 V	66 V	0.170 A	0.190 A
Test position: vertical, cap-up						

Reference ballast characteristics					
Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	9 W	220 V	0.170 A	1.180	0.12

Information for ballast design			
Frequency	Hz		50
Preheat cathode current	A	Min.	0.153
		Max.	0.240
Open circuit voltage across starter	V	Min.(r.m.s)	198
Open circuit voltage across lamp	V	Max. (peak)	400
Substitution resistor for both cathodes in series			160
Voltage across starter with lamp operating	V	Max.(r.m.s)	*
Lamp operating current	A	Max.	0.190

* Under consideration

TABLE (Concluded)

Information for starter design			
Pulse voltage	Non-reclosure voltage	RIS capacitor	
Min.	Max.	Min.	Max.
* V	* V	* nF	* nF

Information for high-frequency ballast design			
Typical lamp characteristics			
Frequency	Lamp wattage	Lamp voltage	Lamp current
20 KHz	8 W	48 V	0.170 A

Current in any lead to cathodes	A	Max.	0.240
Lamp operating current	A	Min.	0.120
		Max.	0.190

Current controlled preheating			
Minimum preheat current i_k (A) emission time t_e (s) $i_k = (a/t_e + i_m^2)^{0.5}$		a	0.025
		i_m(A)	0.135
Maximum preheat current	A	t 0.4	0.400
		0.4 <t < 2.0	0.430 - 0.090t
		t 2.0	0.250
Open circuit voltage across lamp (without starting aid)	t t_e	Max.(r.m.s)	150
	V t>t_e	Min.(r.m.s)	290
Substitution resistor for each cathode		U	50
Voltage controlled preheating			
*			

* Under consideration

FOR 11 W DUAL SHAPE							
Nominal wattage		**Circuit**		**Cathode**		**Cap**	
11 W		External starter		Preheated		2G7	
Starting characteristics							
A		B		C			
Max.		Max.		Max.			
28		13		215			
Starting characteristics							
Frequency		Ballast rated voltage		Test voltage (r.m.s)		Starting time	
50 Hz		220 V		198 V		10 s	
Electrical characteristics							
Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current	
		Rated	Minimum	Maximum			
50 Hz	11.8 W	91 V	81 V	101 V	0.155 A	0.190 A	
Test position : vertical, cap-up							
Reference ballast characteristics							
Frequency	Nominal wattage W	Rated voltage	Calibration current		Voltage/current ratio	Power factor	
50 Hz	9 W	220 V	0.170 A		1180 Ù	0.12	
Information for ballast design							
Frequency		Hz			50		
Preheat cathode current		A	Min.		0.153		
			Max.		0.240		
Open circuit voltage across starter		V	Min. (r.m.s)		198		
Open circuit voltage across lamp		V	Max. (peak)		400		
Substitution resistor for both cathodes in series		Ù			160		
Voltage across starter with lamp operating		V	Max. (r.m.s)		*		
Lamp operating current		A	Max.		0.190		
Information for starter design							
Pulse voltage		Non-reclosure voltage		RIS capacitor			
Minimum		Maximum		Minimum	Maximum		
* V		* V		* nF	* nF		

*Under consideration

TABLE (Concluded)

<table>
<tr><th colspan="6">Information for high-frequency ballast design</th></tr>
<tr><th colspan="6">Typical lamp characteristics</th></tr>
<tr><td>Frequency</td><td>Lamp wattage</td><td colspan="2">Lamp voltage</td><td colspan="2">Lamp current</td></tr>
<tr><td>20 KHz</td><td>11 W</td><td colspan="2">75 V</td><td colspan="2">0.150 A</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="3">Current in any lead to cathodes A</td><td>Max.</td><td colspan="2">0.240</td></tr>
<tr><td colspan="3" rowspan="2">Lamp operating current A</td><td>Min.</td><td colspan="2">0.120</td></tr>
<tr><td>Max.</td><td colspan="2">0.190</td></tr>
<tr><th colspan="6">Current controlled preheating</th></tr>
<tr><td colspan="3" rowspan="2">Minimum preheat current i_k(A) emission time t_e (s)
$i_k = (a/t_e + i_m^2)^{0.5}$</td><td>a</td><td colspan="2">0.025</td></tr>
<tr><td>i_m (A)</td><td colspan="2">0.135</td></tr>
<tr><td colspan="3" rowspan="3">Maixmum preheat current A</td><td>t 0.4</td><td colspan="2">0.400</td></tr>
<tr><td>0.4 <t <2.0</td><td colspan="2">0.430 - 0.090t</td></tr>
<tr><td>t 2.0</td><td colspan="2">0.250</td></tr>
<tr><td colspan="2" rowspan="2">Open circuit voltage across lamp (without starting aid) V</td><td>t t_e</td><td>Max.(r.m.s)</td><td colspan="2">170</td></tr>
<tr><td>t>t_e</td><td>Min.(r.m.s)</td><td colspan="2">330</td></tr>
<tr><td colspan="4">Substitution resistor for each cathode Ù</td><td colspan="2">50</td></tr>
<tr><th colspan="6">Voltage controlled preheating</th></tr>
<tr><td colspan="6">*</td></tr>
</table>

*Under consideration

FOR 18 W DUAL SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
18 W	External starter	Preheated	2G11

Dimensions (mm)

A	B	C
Max.	Max.	Max.
40	20	225

Starting characteristics

Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	110 V	110 V	10 s

Electrical characteristics

Frequency	Rated wattage	Voltage (r.m.s.) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	18 W	58 V	52 V	64 V	0.375 A	0.540

Test position : horizontal, with the plane through the limbs horizontal.

NOTE – *To reduce the time for testing, other positions may be used by agreement between the manufacturer and testing authorities. In cas eof dispute, the horizontal position shall be the reference test position.*

Reference ballast characteristics

Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	20 V	127 V	0.370 A	270 Ù	0.12

Information for ballast design

Frequency	Hz		50
Preheat cathode current	A	Min.	0.315
		Max.	0.670
Open circuit voltage across starter	V	Min. (r.m.s)	103.5
Open circuit voltage across lamp	V	Max. (peak)	400
Substitution resistor for both cathodes in series	Ù		50
Voltage across starter with lamp operating		Max. (r.m.s)	68
Lamp operating current	A	Max.	0.425

FOR 24 W DUAL SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
24 W	External starter	Preheated	2G11

Dimensions (mm)		
A Max.	B Max.	C Max.
40	20	320

Starting characteristics			
Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	220 V	198 V	10 s

Electrical characteristics						
Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	24 W	87 V	77 V	97 V	0.345 A	0.510 A

Test position: horizontal, with the plane through the limbs horizontal.

NOTE

To reduce the time for testing , other positions may be used by agreement between the manufacturer and testing authorities, In case of dispute, the horizontal position shall be the reference test posit

TABLE (Concluded)

Reference ballast characteristics					
Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	24 W	220 V	0.340 A	540	0.10

Information for ballast design			
Frequency	Hz		50
Preheat cathode current	A	Min.	0.315
		Max.	0.670
Open circuit voltage across starter	V	Min.(r.mr.s)	198
Open circuit voltage across lamp	V	Max. (peak)	400
Substitution resistor for both cathodes in series			50
Voltage across starter with lamp operating	V	Max.(r.m.s)	128
Lamp operating current	A	Max.	0.425

Information for starter design			
Pulse voltage	Non-reclosure voltage	RIS capacitor	
Min.	Max.	Min.	Max.
800 V	140 V	* nF	* nF

Information for high-frequency ballast design			
Typical lamp characteristics			
Frequency	Lamp wattage	Lamp voltage	Lamp current
20 KHz	22 W	75 V	0.300 A

Current in any lead to cathodes	A	Max.	0.640
Lamp operating current	A	Min.	0.260
		Max.	0.425

Current controlled preheating			
Minimum preheat current i_k (A) emission time t_e (s) $i_k = (a/t_e + i_m^2)^{0.5}$		a	0.290
		i_m(A)	0.310
Maximum preheat current	A	t 0.4	1.200
		0.4 <t < 2.0	1.350 - 0.350t
		t 2.0	0.650
Open circuit voltage across lamp (without starting aid)	t t_e	Max.(r.m.s)	170
	V t> t_e	Min.(r.m.s)	320
Substitution resistor for each cathode		Ù	12.5

Voltage controlled preheating
*

* Under consideration

FOR 27 W DUAL SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
27 W	External starter	Preheated	GY10q-4

Dimensions (mm)			
A Max.	B Max.	C	
		Min.	Max.
44	21	240	265

Starting characteristics			
Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	100 V	94 V	10 s

Electrical characteristics						
Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	27 W	56 V	50 V	62 V	0.610 A	0.850 A
Test position: vertical, cap-up						

Reference ballast characteristics					
Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	27 W	100 V	0.620 A	118	0.075

Information for ballast design			
Frequency	Hz		50
Preheat cathode current	A	Min.	0.640
		Max.	1.100
Open circuit voltage across starter	V	Min.(r.mr.s)	97
Open circuit voltage across lamp	V	Max. (peak)	400
Substitution resistor for both cathodes in series			30
Voltage across starter with lamp operating	V	Max.(r.m.s)	65
Lamp operating current	A	Max.	*

Information for starter design			
Pulse voltage	Non-reclosure voltage	RIS capacitor	
Min.	Max.	Min.	Max.
700 V	70 V	5.0 nF	10.0 nF

FOR 28 W DUAL SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
28 W	External starter	Preheated	GY10q-5

Dimensions (mm)			
A	B	C	
Max.	Max.	Min.	Max.
44	21	317	340

Starting characteristics			
Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	147 V	137 V	10 s

Electrical characteristics						
Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	28.4 W	83 V	77 V	89 V	0.425 A	0.610 A
Test position: vertical, cap-up						

Reference ballast characteristics					
Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	28 W	147 V	0.435 A	241	0.075

Information for ballast design			
Frequency	Hz		50
Preheat cathode current	A	Min.	0.450
		Max.	0.800
Open circuit voltage across starter	V	Min.(r.m.s)	140
Open circuit voltage across lamp	V	Max. (peak)	400
Substitution resistor for both cathodes in series			40
Voltage across starter with lamp operating	V	Max.(r.m.s)	93
Lamp operating current	A	Max.	*

Information for starter design			
Pulse voltage Min.	Non-reclosure voltage Max.	RIS capacitor	
		Min.	Max.
700 V	96 V	5.0 nF	10.0 nF

* Under consideration

FOR 30 W DUAL SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
30 W	External starter	Preheated	GY10q-4

Dimensions (mm)			
A	B	C	
Max.	Max.	Min.	Max.
54	25	270	280

Starting characteristics			
Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	100 V	94 V	10 s

Electrical characteristics						
Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	29 W	55 V	49 V	61 V	0.620 A	0.850 A
Test position: vertical, cap-up						

Reference ballast characteristics					
Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	30 W	100 V	0.620 A	118	0.075

Information for ballast design			
Frequency	Hz		50
Preheat cathode current	A	Min.	0.640
		Max.	1.100
Open circuit voltage across starter	V	Min.(r.m.s)	97
Open circuit voltage across lamp	V	Max. (peak)	400
Substitution resistor for both cathodes in series			30
Voltage across starter with lamp operating	V	Max.(r.m.s)	65
Lamp operating current	A	Max.	*

Information for starter design			
Pulse voltage	Non-reclosure voltage	RIS capacitor	
Min.	Max.	Min.	Max.
700 V	70 V	5.0 nF	10.0 nF

*Under consideration

FOR 36 W DUAL SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
36 W	External starter	Preheated	GY10q-6

Dimensions (mm)			
A	B	C	
Max.	Max.	Min.	Max.
44	21	405	430

Starting characteristics			
Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	200 V	180 V	10 s

Electrical characteristics						
Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	36 W	105 V	97 V	113 V	0.435 A	0.630 A
Test position: vertical, cap-up						

Reference ballast characteristics					
Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	36 W	200 V	0.435 A	341	0.075

Information for ballast design			
Frequency	Hz		50
Preheat cathode current	A	Min.	0460
		Max.	0.830
Open circuit voltage across starter	V	Min.(r.m.s)	185
Open circuit voltage across lamp	V	Max. (peak)	400
Substitution resistor for both cathodes in series			40
Voltage across starter with lamp operating	V	Max.(r.m.s)	119
Lamp operating current	A	Max.	*

Information for starter design			
Pulse voltage	Non-reclosure voltage	RIS capacitor	
Min.	Max.	Min.	Max.
800 V	134 V	5.0 nF	10.0 nF

*Under consideration

FOR 36 W DUAL SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
36 W	External starter	Preheated	2G11

Dimensions (mm)

A Max.	B Max.	C Max.
40	20	415

Starting characteristics

Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	220 V	198 V	10 s

Electrical characteristics

Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	36 W	106 V	96 V	116 V	0.435 A	0.650 A

Test position: horizontal, with the plane through the limbs horizontal.

Note – *To reduce the time for testing , other positions may be used by agreement between the manufacturer and testing authorities, In case of dispute, the horizontal position shall be the reference test position.*

Reference ballast characteristics

Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	40 W	220 V	0.430 A	390	0.10

Information for ballast design

Frequency	Hz		50
Preheat cathode current	A	Min.	0.365
		Max.	0.775
Open circuit voltage across starter	V	Min.(r.mr.s)	198
Open circuit voltage across lamp	V	Max. (peak)	400
Substitution resistor for both cathodes in series			40
Voltage across starter with lamp operating	V	Max.(r.m.s)	128
Lamp operating current	A	Max.	0.500

TABLE (Concluded)

Information for starter design			
Pulse voltage Min.	Non-reclosure voltage Max.	RIS capacitor Min.	 Max.
800 V	140 V	* nF	* nF

Information for high-frequency ballast design				
Typical lamp characteristics				
Frequency	Lamp wattage	Lamp voltage	Lamp current	
20 KHz	32 W	90 V	0.360 A	
Current in any lead to cathodes		A	Max.	0.700
Lamp operating current		A	Min.	0.300
			Max.	0.500
Current controlled preheating				
Minimum preheat current i_k (A) emission time t_e (s) $i_k = (a/t_e + i_m^2)^{0.5}$			a	0.380
			i_m(A)	0.360
Maximum preheat current		A	t 0.4	1.400
			0.4 <t < 2.0	1.550 - 0.400t
			t 2.0	0.750
Open circuit voltage across lamp (without starting aid)		t t_e	Max.(r.m.s)	190
	V	t>t_e	Min.(r.m.s)	340
Substitution resistor for each cathode			Ù	10
Voltage controlled preheating				
*				

* Under consideration

FOR 40 W DUAL SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
40 W	HF starterless	Non-preheated	2G11

Dimensions (mm)		
A Max.	B Max.	C Max.
40	20	535

Starting characteristics		
Frequency	Open circuit voltage (r.m.s)	Starting time
20 – 26 KHz	475 V	0.1 s

Electrical characteristics					
Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current
		Rated	Minimum	Maximum	
20-26 kHz	40 W	126 V	116 V	136 V	0.320 A

Test position: horizontal, with the plane through the limbs horizontal.

Note – *To reduce the time for testing , other positions may be used by agreement between the manufacturer and testing authorities, In case of dispute, the horizontal position shall be the reference test position*

Reference ballast characteristics				
Frequency	Nominal wattage	Rated voltage	Calibration current	Resistance
20.26 kHz	40 W	254 V	0.320 A	400

Information for HF ballast design			
Frequency	kHz		20
Open circuit voltage lamp	V	Min.(r.m.s)	800
Current through lamp substitution resistor	A	Min.	0.200
Lamp substitution resistor			1 000
Substitution resistor for each cathode			2
Cathode current		Max.	1.500
Current in any lead to cathodes	A	Max.	0.640
Lamp operating current	A	Min.	0.260
		Max.	0.425

FOR 40 W DUAL SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
40 W	HF starterless	Preheated	2G11

Dimensions (mm)

A	B	C
Max.	Max.	Max.
40	20	535

Starting characteristics

Frequency	Preheat current	Preheat time	Open circuit voltage (r.m.s.)	Starting time
20-26 KHz	0.470 A	2 s	350 V	0.1 s

Electrical characteristics

Frequency	Rated wattage	Voltage (r.m.s)at lamp terminals			Rated lamp current
		Rated	Minimum	Maximum	
20-26 KHz	40 W	126 V	116 V	136 V	0.320 A

Test position : horizontal with the plane through the limbs horizontal .

NOTE : *To reduce the time for testing , other options may be used by agreement between the manufactures and testing authorities.*
In case of dispute, the horizontal position shall be the reference test position.

Cathode characteristics

Test current	Resistance of each cathode		
	Rated	Minimum	Maximum
0.470 A	16 Ù	11 Ù	* Ù

Reference ballast characteristics

Frequency	Nominal wattage	Rated voltage	Calibration current	Resistance
20-26 KHz	40 W	254 V	0.320 A	400 Ù

Information of HF ballast design

Frequency	kHz		20
Current in any lead to cathodes	A	Max.	0.640
Lamp operating current	A	Min.	0.260
		Max.	0.425

* Under consideration

TABLE (Concluded)

Current controlled preheating			
Minimum preheat current I_k (A) to emission time t_e(s)	a		0.290
	i_m (A)		0.310
Maximum preheat current A	t 0.4		1 200
	0.4 <t<2.0		1 350-0.350 t
	t 2.0		0.650
Open circuit voltage across lamp (without starting aid) V	t t_o	Max.9r.m.s)	220
	t>t_o	Min.(r.m.s)	360
Substitution resistor for each cathode Ù			12.5
Voltage controlled preheating			
*			

* Under consideration.

FOR 10 W QUAD SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
10 W	Internal starter	Preheated	G24d-1

Dimensions (mm)		
A Max.	B Max.	C Max.
28	13	95

Starting characteristics			
Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	220 V	198 V	10 s

Electrical characteristics						
Frequency	Rated watage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	10 W	64 V	58 V	70 V	0.190 A	0.210 A
Test position: vertical, cap-up						

Reference ballast characteristics					
Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	10 W	220 V	0.190 A	1.070	0.12

Information for ballast design			
Frequency	Hz		50
Preheat cathode current	A	Min.	0.153
		Max.	0.275
Open circuit voltage across lamp	V	Min.(r.mr.s)	198
		Max. (peak)	400
Substitution resistor for both cathodes in series			100
Lamp operating current	A	Max.	0.210

FOR 13 W QUAD SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
13 W	Internal starter	Preheated	G24d-1

Dimensions (mm)		
A	B	C
Max.	Max.	Max.
28	28	130

Starting characteristics			
Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	220 V	198 V	10 s

Electrical characteristics						
Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	13 W	91 V	81 V	101 V	0.175 A	0.210 A
Test position: vertical, cap-up						

Reference ballast characteristics					
Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	13 W	220 V	0.165 A	1 070 Ù	0.12

Information for ballast design			
Frequency	Hz		50
Preheat cathode current	A	Min.	0.153
		Max.	0.275
Open circuit voltage across lamp	V	Min (r.m.s)	198
		Max. (peak)	400
Substitution resistor for both cathodes in series		Ù	100
Lamp operating current		Max.	0.190

FOR 18 W QUAD SHAPE						
Nominal wattage	**Circuit**	**Cathode**	**Cap**			
18 W	Internal starter	Preheated	G24d-2			
Dimensions (mm)						
A	B	C				
Max.	Max.	Max.				
28	28	150				
Starting characteristics						
Frequency	Ballast rated voltage	Test voltage (r.m.s.)	Starting time			
50 Hz	220 V	198 V	10 s			
Electrical characteristics						
Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	18 W	100 V	90 V	110 V	0.220 A	0.280 A
Test position: vertical, cap-up						
Reference ballast characteristics						
Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor	
50 Hz	18 W	220	0.220 A	800 Ù	0.12	
Information for ballast design						
Frequency	Hz		50			
Preheat cathode current	A	Min.	0.190			
		Max.	0.375			
Open circuit voltage across lamp	V	Min.. (r.m.s)	198			
		Max. (peak)	400			
Substitution resistor for both cathodes in series	Ù		80			
Lamp operating current		Max.	0.240			

FOR 26 W QUAD SHAPE						
Nominal wattage	**Circuit**	**Cathode**	**Cap**			
26 W	Internal starter	Preheated	G24d-3			
Dimensions (mm)						
A	B	C				
Max.	Max.	Max.				
28	28	170				
Starting characteristics						
Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time			
50 Hz	220 V	198 V	10 s			
Electrical characteristics						
Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	26 W	105 V	95 V	115 V	0.325 A	0.420 A
Test position: vertical, cap-up						
Reference ballast characteristics						
Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor	
50 Hz	26 W	220 V	0.315 A	540 Ù	0.10	
Information for ballast design						
Frequency	Hz		50			
Preheat cathode current	A	Min.	0.270			
		Max.	0.550			
Open circuit voltage across lamp	V	Max. (r.m.s)	19			
		Max. (peak)	400			
Substitution resistor for both cathodes in series	Ù		25			
Lamp operating current		Max.	0.360			

FOR 10 W QUAD SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
10 W	External starter	Preheated	G24q-1

Dimensions (mm)		
A Max.	B Max.	C Max.
28	28	95

Starting characteristics			
Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	220 V	198 V	10 s

Electrical characteristics						
Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	10 W	64 V	58 V	70 V	0.190 A	0.210 A
Test position: vertical, cap-up						

Reference ballast characteristics					
Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	10 W	220 V	0.190 A	1 070	0.12

Information for ballast design			
Frequency	Hz		50
Preheat cathode current	A	Min.	0.153
		Max.	0.275
Open circuit voltage across starter	V	Min.(r.m.s)	198
Open circuit voltage across lamp	V	Max. (peak)	400
Substitution resistor for both cathodes in series			100
Voltage across starter with lamp operating	V	Max.(r.m.s)	*
Lamp operating current	A	Max.	0.210

* Under consideration

TABLE (Concluded)

Information for starter design			
Pulse voltage Min.	Non-reclosure voltage Max.	RIS capacitor Min.	Max.
* V	* V	* nF	* nF

Information for high-frequency ballast design			
Typical lamp characteristics			
Frequency	Lamp wattage	Lamp voltage	Lamp current
20 KHz	9.5 W	51 V	0.190 A

Current in any lead to cathodes	A	Max.	0.240
Lamp operating current	A	Min.	0.135
		Max.	0.210

Current controlled preheating			
Minimum preheat current i_k (A) emission time t_e (s) $i_k = (a/t_e + i_m^2)^{0.5}$		a	0.045
		i_m(A)	0.140
Maximum preheat current A		t 0.4	0.460
		0.4 <t < 2.0	0.500 - 0.110t
		t 2.0	0.280
Open circuit voltage across lamp (without starting aid) V	t t_e	Max.(r.m.s)	180
	t>t_e	Min.(r.m.s)	340
Substitution resistor for each cathode		Ù	35

Voltage controlled preheating
*

* Under consideration

FOR 13 W QUAD SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
13W	External starter	Preheated	G24q-1

Dimensions (mm)		
A	B	C
Max.	Max.	Max.
28	28	130

Starting characteristics			
Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	220 V	198	10 s

Electrical characteristics						
Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	13 W	91 V	81 V	101 V	0.175 A	0.210 A

Test position: vertical, cap-up

Reference ballast characteristics					
Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	13 W	220 V	0.165 A	1070	0.12

Information for ballast design			
Frequency	Hz		50
Preheat cathode current	A	Min.	0.153
		Max.	0.275
Open circuit voltage across starter	V	Min.(r.mr.s)	198
Open circuit voltage across lamp	V	Max. (peak)	400
Substitution resistor for both cathodes in series			100
Voltage across starter with lamp operating	V	Max.(r.m.s)	*

Information for starter design			
Pulse voltage	Non-reclosure voltage	RIS capacitor	
Min.	Max.	Min.	Max.
* V	* V	* nF	*nF

* Under consideration

TABLE (Concluded)

<table>
<tr><th colspan="6">Information for high-frequency ballast design</th></tr>
<tr><th colspan="6">Typical lamp characteristics</th></tr>
<tr><td>Frequency</td><td>Lamp wattage</td><td colspan="2">Lamp voltage</td><td colspan="2">Lamp current</td></tr>
<tr><td>20 KHz</td><td>12.5 W</td><td colspan="2">77 V</td><td colspan="2">0.165 A</td></tr>
<tr><td colspan="3">Current in any lead to cathodes A</td><td>Max.</td><td colspan="2">0.240</td></tr>
<tr><td colspan="3" rowspan="2">Lamp operating current A</td><td>Min.</td><td colspan="2">0.120</td></tr>
<tr><td>Max.</td><td colspan="2">0.190</td></tr>
<tr><th colspan="6">Current controlled preheating</th></tr>
<tr><td colspan="3" rowspan="2">Minimum preheat current i_k (A) emission time t_e (s)
$i_k = (a/t_e + i_m^2)^{0.5}$</td><td>a</td><td colspan="2">0.025</td></tr>
<tr><td>i_m(A)</td><td colspan="2">0.135</td></tr>
<tr><td colspan="3" rowspan="3">Maximum preheat current A</td><td>t 0.4</td><td colspan="2">0.400</td></tr>
<tr><td>0.4 <t < 2.0</td><td colspan="2">0.430 – 0.090 t</td></tr>
<tr><td>t 2.0</td><td colspan="2">0.250</td></tr>
<tr><td colspan="2" rowspan="2">Open circuit voltage across lamp (without starting aid) V</td><td>t t_e</td><td>Max.(r.m.s)</td><td colspan="2">190</td></tr>
<tr><td>t>t_e</td><td>Min.(r.m.s)</td><td colspan="2">380</td></tr>
<tr><td colspan="4">Substitution resistor for each cathode Ù</td><td colspan="2">50</td></tr>
<tr><th colspan="6">Voltage controlled preheating</th></tr>
<tr><td colspan="6">*</td></tr>
</table>

* Under consideration

FOR 18 W QUAD SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
18 W	External starter	Preheated	G24q-2

Dimensions (mm)

A	B	C
Max.	Max.	Max.
28	28	150

Starting characteristics

Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	220 V	198 V	10 s

Electrical characteristics

Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	18 W	100 V	90 V	110 V	0.220 A	0.280 A

Test position: vertical, cap-up

Reference ballast characteristics

Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	18 W	220 V	0.220 A	800 Ù	0.12

Information for ballast design

Frequency	Hz		50
Preheat cathode current	A	Min.	0.190
		Max.	0.375
Open circuit voltage across starter	V	Min. (r.m.s)	198
		Max. (peak)	400
Substitution resistor for both cathodes in series	Ù		80
Voltage across starter with lamp operating	V	Max.(r.m.s)	*
Lamp operating current		Max.	0.240

Information for starter design

Pulse voltage		Non-reclosure voltage		RIS capacitor	
Minimum		Maximum		Minimum	Maximum

* Under consideration.

TABLE (Concluded)

<table>
<tr><th colspan="6">Information for high-frequency ballast design</th></tr>
<tr><th colspan="6">Typical lamp characteristics</th></tr>
<tr><td>Frequency</td><td>Lamp wattage</td><td colspan="2">Lamp voltage</td><td colspan="2">Lamp current</td></tr>
<tr><td>20 KHz</td><td>16.5 W</td><td colspan="2">80 V</td><td colspan="2">0.210 A</td></tr>
<tr><td colspan="3">Current in any lead to cathodes A</td><td>Max.</td><td colspan="2">0.330</td></tr>
<tr><td colspan="3" rowspan="2">Lamp operating current A</td><td>Min.</td><td colspan="2">0.160</td></tr>
<tr><td>Max.</td><td colspan="2">0.240</td></tr>
<tr><td colspan="6">Current controlled preheating</td></tr>
<tr><td colspan="3" rowspan="2">Minimum preheat current i_k(A emission time t_e (s)
$i_k = (a/t_e + i_m^2)^{0.5}$</td><td>a</td><td colspan="2">0.044</td></tr>
<tr><td>i_m (A)</td><td colspan="2">0.170</td></tr>
<tr><td colspan="3" rowspan="3">Maximum preheat current A</td><td>t 0.4</td><td colspan="2">0.500</td></tr>
<tr><td>0.4 <t < 2.0</td><td colspan="2">0.550-.0.115t</td></tr>
<tr><td>t 2.0</td><td colspan="2">0.320</td></tr>
<tr><td colspan="2" rowspan="2">Open circuit voltage across lamp (without starting aid) V</td><td>t t_e</td><td>Max.(r.m.s)</td><td colspan="2">220</td></tr>
<tr><td>t>t_e</td><td>Min.(r.m.s)</td><td colspan="2">400</td></tr>
<tr><td colspan="4">Substitution resistor for each cathode Ù</td><td colspan="2">30</td></tr>
<tr><td colspan="6">Voltage controlled preheating</td></tr>
<tr><td colspan="6">*</td></tr>
</table>

* Under consideration.

FOR 26 W QUAD SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
26 W	External starter	Preheated	G24q-3

Dimensions (mm)		
A Max.	B Max.	C Max.
28	28	170

Starting characteristics			
Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	220 V	198 V	10 s

Electrical characteristics						
Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	26 W	105 V	95 V	115 V	0.325 A	0.420 A
Test position: vertical, cap-up						

Reference ballast characteristics					
Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	26 W	220 V	0.315 A	540	0.10

Information for ballast design			
Frequency	Hz		50
Preheat cathode current	A	Min.	0.270
		Max.	0.550
Open circuit voltage across starter	V	Min.(r.m.s)	198
Open circuit voltage across lamp	V	Max. (peak)	400
Substitution resistor for both cathodes in series			25
Voltage across starter with lamp operating	V	Max.(r.m.s)	*
Lamp operating current	A	Max.	0.360

* Under consideration

TABLE (Concluded)

<table>
<tr><th colspan="6">Information for starter design</th></tr>
<tr><td colspan="2">Pulse voltage
Min.</td><td colspan="2">Non-reclosure voltage
Max.</td><td colspan="2">RIS capacitor
Min. / Max.</td></tr>
<tr><td colspan="2">* V</td><td colspan="2">* V</td><td>* nF</td><td>* nF</td></tr>
<tr><th colspan="6">Information for high-frequency ballast design</th></tr>
<tr><th colspan="6">Typical lamp characteristics</th></tr>
<tr><td>Frequency</td><td>Lamp wattage</td><td colspan="2">Lamp voltage</td><td colspan="2">Lamp current</td></tr>
<tr><td>20 KHz</td><td>24 W</td><td colspan="2">80 V</td><td colspan="2">0.300 A</td></tr>
<tr><td colspan="3">Current in any lead to cathodes A</td><td>Max.</td><td colspan="2">0.480</td></tr>
<tr><td colspan="3" rowspan="2">Lamp operating current A</td><td>Min.</td><td colspan="2">0.220</td></tr>
<tr><td>Max.</td><td colspan="2">0.360</td></tr>
<tr><th colspan="6">Current controlled preheating</th></tr>
<tr><td colspan="3" rowspan="2">Minimum preheat current i_k (A) emission time t_e (s)
$i_k = (a/t_e + i_m^2)^{0.5}$</td><td>a</td><td colspan="2">0.130</td></tr>
<tr><td>i_m(A)</td><td colspan="2">0.250</td></tr>
<tr><td colspan="3" rowspan="3">Maximum preheat current A</td><td>t 0.4</td><td colspan="2">0.850</td></tr>
<tr><td>0.4 <t < 2.0</td><td colspan="2">0.940.0,230 t</td></tr>
<tr><td>t 2.0</td><td colspan="2">0.480</td></tr>
<tr><td colspan="2" rowspan="2">Open circuit voltage across lamp (without starting aid) V</td><td>t t_e</td><td>Max.(r.m.s)</td><td colspan="2">240</td></tr>
<tr><td>t>t_e</td><td>Min.(r.m.s)</td><td colspan="2">420</td></tr>
<tr><td colspan="4">Substitution resistor for each cathode Ù</td><td colspan="2">10</td></tr>
<tr><th colspan="6">Voltage controlled preheating</th></tr>
<tr><td colspan="6">*</td></tr>
</table>

* Under consideration

FOR 13 W QUAD SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
13 W	External starter	Preheated	GX10q-2

Dimensions (mm)

A Max.	B Max.	C Min.	C Max.
39	39	105	120

Starting characteristics

Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	100 V	94 V	10 s

Electrical characteristics

Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	13.3 W	54 V	48 V	60 V	0.300 A	0.440 A

Test position: vertical, cap-up

Reference ballast characteristics

Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	13 W	100 V	0.300 A	244	0.075

Information for ballast design

Frequency	Hz		50
Preheat cathode current	A	Min.	0.320
		Max.	0.580
Open circuit voltage across starter	V	Min.(r.m.s)	97
Open circuit voltage across lamp	V	Max. (peak)	400
Substitution resistor for both cathodes in series			50
Voltage across starter with lamp operating	V	Max.(r.m.s)	65
Lamp operating current	A	Max.	*

Information for starter design

Pulse voltage Min.	Non-reclosure voltage Max.	RIS capacitor Min.	RIS capacitor Max.
700 V	70 V	5.0 nF	10.0 nF

* Under consideration

FOR 18 W QUAD SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
18 W	External starter	Preheated	GX10q-3

Dimensions (mm)		
A	B	C
Max.	Max.	Max.
39	39	128

Starting characteristics			
Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	100 V	94 V	10 s

Electrical characteristics						
Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	17.5 W	55 V	49 V	61 V	0.375 A	0.530 A
Test position: vertical, cap-up						

Reference ballast characteristics					
Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	18 W	100	0.375 A	190 Ù	0.075

Information for ballast design			
Frequency	Hz		50
Preheat cathode current	A	Min.	0.380
		Max.	0.730
Open circuit voltage across starter		Min (r.m.s)	97
Open circuit voltage across	V	Max. (peak)	400
Substitution resistor for both cathodes in series	Ù		50
Voltage across starter with lamp operating	V	Max .(r.m.s)	65
Lamp operating current		Max.	*

Information for starter design			
Pulse voltage	Non-reclosure voltage	RIS capacitor	
Minimum	Maximum	Minimum	Maximum
700 V	70 V	5.0 nF	10.0 nF

* Under consideration.

FOR 27 W QUAD SHAPE			
Nominal wattage	**Circuit**	**Cathode**	**Cap**
27 W	External starter	Preheated	GX10q-4

Dimensions (mm)			
A	B	C	
Max.	Max.	Min.	Max.
39	39	120	142

Starting characteristics			
Frequency	Ballast rated voltage	Test voltage (r.m.s)	Starting time
50 Hz	100 V	94 V	10 s

Electrical characteristics						
Frequency	Rated wattage	Voltage (r.m.s) at lamp terminals			Rated lamp current	Rated preheat current
		Rated	Minimum	Maximum		
50 Hz	26.8 W	56 V	50 V	62 V	0.610 A	0.850 A
Test position: vertical, cap-up						

Reference ballast characteristics					
Frequency	Nominal wattage	Rated voltage	Calibration current	Voltage/current ratio	Power factor
50 Hz	27 W	100 V	0.620 A	118	0.075

Information for ballast design			
Frequency	Hz		50
Preheat cathode current	A	Min.	0.640
		Max.	1.100
Open circuit voltage across starter	V	Min.(r.m.s)	97
Open circuit voltage across lamp	V	Max. (peak)	400
Substitution resistor for both cathodes in series			30
Voltage across starter with lamp operating	V	Max.(r.m.s)	65
Lamp operating current	A	Max.	*

Information for starter design			
Pulse voltage	Non-reclosure voltage	RIS capacitor	
Min.	Max.	Min.	Max.
700 V	70 V	5.0 nF	10.0 nF

* Under consideration.

APPENDIX B
METHOD OF MEASURING LAMP CHARACTERISTICS

B.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)[-1.] 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.

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) :

TABLE 7 – 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 8 – 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 9 – 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 B_1 for standard colour F 6500, 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, as specified on the relevant lamp data sheet, slightly, shifted chromaticity coordinates apply, but only for types having a general colour rendering index less than 80.

The same tolerance areas as given in Figure B_1 in shall be used, but centred on the rated values given in the following Table **5** :

TABLE 10 - Rated values of x and y for standardized chromaticity coordinates

"Colour"	X	Y
(1)	(2)	(3)
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	-	-

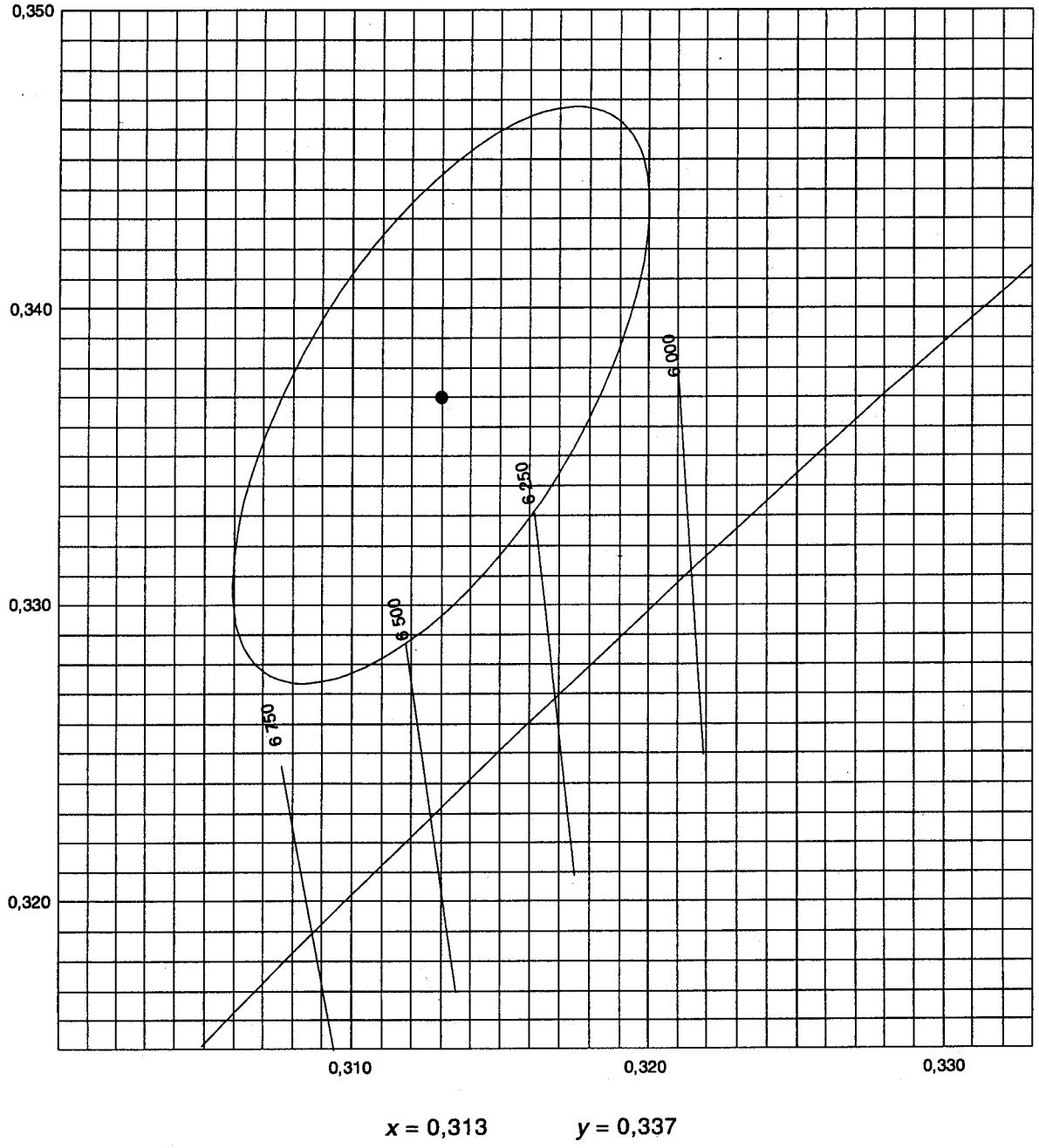


FIGURE 15 - Tolerance area for standard colour F 6500

SRI LANKA STANDARDS INSTITUTION

The Sri Lanka Standards Institution (SLSI) is the National Standards Organization of Sri Lanka established under the Sri Lanka Standards Institution Act No. 6 of 1984 which repealed and replaced the Bureau of Ceylon Standards Act No. 38 of 1964. The Institution functions under the Ministry of Science & Technology.

The principal objects of the Institution as set out in the Act are to prepare standards and promote their adoption, to provide facilities for examination and testing of products, to operate a Certification Marks Scheme, to certify the quality of products meant for local consumption or exports and to promote standardization and quality control by educational, consultancy and research activity.

The Institution is financed by Government grants, and by the income from the sale of its publications and other services offered for Industry and Business Sector. Financial and administrative control is vested in a Council appointed in accordance with the provisions of the Act.

The development & formulation of National Standards is carried out by Technical Experts and representatives of other interest groups, assisted by the permanent officers of the Institution. These Technical Committees are appointed under the purview of the Sectoral Committees which in turn are appointed by the Council. The Sectoral Committees give the final Technical approval for the Draft National Standards prior to the approval by the Council of the SLSI.

All members of the Technical & Sectoral Committees render their services in an honorary capacity. In this process the Institution endeavours to ensure adequate representation of all view points.

In the International field the Institution represents Sri Lanka in the International Organization for Standardization (ISO), and participates in such field of standardization as are of special interest to Sri Lanka.

Printed at the Sri Lanka Standards Institution, 17, Victoria Place, Elvitigala Mawatha, Colombo 08.

SLS CERTIFICATION MARK

The Sri Lanka Standards Institution is the owner of the registered certification mark shown below. Beneath the mark, the number of the Sri Lanka Standard relevant to the product is indicated. This mark may be used only by those who have obtained permits under the SLS certification marks scheme. The presence of this mark on or in relation to a product conveys the assurance that they have been produced to comply with the requirements of the relevant Sri Lanka Standard under a well designed system of quality control inspection and testing operated by the manufacturer and supervised by the SLS/ *which includes surveillance inspection of the factory, testing of both factory and market samples.*

Further particulars of the terms and conditions of the permit may be obtained from the Sri *Lanka Standards Institution, 17, Victoria Place, Elvitigala Mawatha, Colombo 08.*

Printed at SLSI (Printing Unit)