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**LIGHTING DEVICES FOR USE IN PHOTOVOLTAIC
SYSTEMS - Specification**

draft for public comment - only

ZAMBIA BUREAU OF STANDARDS

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FOREWORD

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The preparation of this Standard has been undertaken by the Photovoltaic Systems Technical Committee (TC 5/6). The revision of this standard was necessary to ensure that technological advancements are taken into consideration.

In the preparation of this standard, the following publications were consulted:

- SAZS 523, Standard specification for fluorescent lights for use in photovoltaic systems.
- NRS 052, Standard specification for photovoltaic systems for use in individual homes.
- “Universal technical standard for solar home systems” Thermie B SUP 995-96, EC-DGXVII

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ZAMBIA BUREAU OF STANDARDS

Zambian Standard

LIGHTING DEVICES FOR USE IN PHOTOVOLTAIC SYSTEMS - Specification

1 SCOPE

This Zambian Standard specifies minimum requirements for lighting devices for use in photovoltaic systems powered with direct current (DC) or alternating current (AC) and may have an inverter ballast or driver circuit.

2 NORMATIVE REFERENCES

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. All standards are subject to revision and, since any reference to a standard is deemed to be the latest reference to the latest edition of that standard, parties to agreements based on this standard are encouraged to take steps to ensure the use of the most recent editions of the standards indicated below. Information on currently valid national and international standards may be obtained from the Zambia Bureau of Standards:

ZS IEC TS 61836 Solar photovoltaic energy systems – Terms and Symbols

ZS IEC 60969 Self-ballasted lamps for general lighting services - Performance requirements

ZS IEC 62717 LED modules for general lighting - Performance requirements

3 DEFINITIONS

For the purpose of this standard, terms and definitions in ZS IEC 61836 shall apply as well as the following:

3.1 Ampere

Amount of electric charge passing through a cross-section area of a conductor per unit time. This flow produces a voltage drop of one volt across one ohm of resistance.

3.2 Ballast

A device used to start and run a gas discharge type lamp.

3.3 Battery

A band of cells connected together so as to produce and store useful electrical energy. Conforming to ZS 403

3.4 Charge Controller

A device which can accept information from the battery, solar panel and load and by predetermined instructions automatically carry out the correct sequence of regulation. Conforming to ZS 404

3.5 Compact Fluorescent Lamp

A low-wattage energy-efficient fluorescent light bulb that has been compressed into the size of a standard-issue incandescent light bulb.

3.6 Electric Current:

The flow of charge through a material

3.7 Fluorescent light

An electrical discharge lamp in which phosphors in the coating of the tube transform electrical energy into light with high efficiency.

3.8 Fuse

A device for protecting an electric circuit which disconnects the circuit under faulty conditions with a current overload

3.9 Interference

The undesired electromagnetic emission from a device which causes disturbances to other devices.

3.10 Inverter

A device that converts direct current into alternating current.

3.11 Load

A power consuming device (e.g. light device or radio).

3.12 Light Emitting Diode (LED)

Light-Emitting Diode is a solid-state semiconductor device that converts electrical energy directly into light when an electrical current is passed through it.

3.13 Light Emitting Diode (LED) Driver/Ballast

An electronic device used to deliver a constant voltage and current suitable for safely operating an LED.

3.14 Lumen per watt

A measure of visible light intensity per input power.

3.15 Polarity

A property with respect to the direction of flow of electrons in a conductor. It is characterized by the existence of opposite charges, positive and negative.

3.16 Root mean square

Root Mean Square (rms) of amperes or volts, the square root of the average (mean) value of the square of the instantaneous values taken over a complete cycle.

3.17 Switch

A device for opening or closing, an electrically operated circuit.

3.18 Volt

The practical unit of emf and potential difference (pd). One unit of this emf or pd which, when applied to a resistance of one ohm produces a current of one ampere.

4 OPERATING CONDITIONS FOR LIGHTING DEVICES

4.1 Fluorescent Lights

4.1.1 Operating Voltage Range

The input dc voltage operating range of the fluorescent lights shall start at and run from 85% to 125% of the nominal voltage (i.e., 10.2 V to 15 V for 12 V battery) without any detrimental effect on the life span and operation of the light system at an ambient temperature of 0°C to 35°C.

4.1.2 Luminous Performance

The luminous efficacy of a light system shall be at least 40 lum/W.

4.1.3 Output Waveform Symmetry

The electrical waveform on the fluorescent tube shall be symmetrical in time to within 10 % (i.e., 60 to 40 % waveform maximum difference in symmetry) over the voltage range of ± 10 % of the nominal voltage at an ambient temperature of 25°C. A maximum "crest factor" [ratio of maximum peak to root mean square (rms) voltage] for the fluorescent tube shall not exceed 2.

4.1.4 Reverse Polarity Protection

The inverter-ballast shall not be damaged when the nominal voltage is applied in a reversed connection and zero current shall flow during this period.

4.1.5 Open Circuit Protection

Application of power at the nominal voltage after failure or removal of the tube shall not cause damage to the inverter-ballast. With the tube removed or non-functional, the current consumption of the inverter-ballast shall not exceed 15 % of its rated operating current.

4.1.6 Over-current Protection

All inverter-ballast shall be fitted with a fuse that is one and half times the maximum rated current. This shall be placed so as to protect the entire circuitry.

4.1.7 Switches

In the case where a switch (rated at the voltage of the appliance) is fitted, it shall provide at least 10,000 cycles with a maximum voltage across the switch of 10 mV at a maximum marked rated current.

4.1.8 Lamp Covers

Lamp lenses, covers and grids, shall be easily removable by the end-user to effect tube replacement and cleaning operations.

4.1.9 Housing

The inverter-ballast compartment shall not have an opening of more than 3 mm when fully installed.

4.2 Compact Fluorescent Lamp (CFL)

There are two types of Compact Fluorescent Lamps. Those designed to operate on Alternating Current and those designed to operate on Direct Current.

4.2.1 Operating Voltage Range

The input dc voltage operating range of the CFL shall start at and run from 85% to 125% of the nominal voltage (i.e., 10.2 V to 15 V for 12 V battery) without any detrimental effect on the life span and operation of the light system at an ambient temperature of 0°C to 35°C.

The input ac voltage operating range of the CFL shall start at and run from 90% to 110% of the nominal voltage (i.e., 220 V to 240 V for 230 supply voltage battery) without any detrimental effect on the life span and operation of the light system at an ambient temperature of 0°C to 35°C.

4.2.2 Luminous Performance

The luminous efficacy of a light system shall be at least 40 lumens/Watt

4.2.3 Output Waveform Symmetry

The electrical waveform on the Compact Fluorescent Lamp shall be symmetrical in time to within 10 % (i.e., 60 to 40 % waveform maximum differences in symmetry) over the voltage range of ± 10 % of the nominal voltage at an ambient temperature of 25°C. A maximum "crest factor" [ratio of maximum peak to root mean square (rms) voltage] for the CFL shall not exceed 2.

4.2.4 Reverse Polarity Protection

The inverter- ballast shall not be damaged when the nominal voltage is applied in a reversed connection and zero current shall flow during this period.

4.2.5 Open Circuit Protection

Application of power at the nominal voltage after failure or removal of the bulb shall not cause damage to the inverter-ballast.

4.2.6 Over-current Protection

All lighting devices shall have over-current protection capability.

4.2.7 Switches

In the case where a switch (rated at the voltage of the appliance) is fitted, it shall provide at least 10,000 cycles with a maximum voltage across the switch of 10 mV at a maximum marked rated current.

4.3 Light Emitting Diode (LED) Lamps

There are two types of Light Emitting Diode (LED) Lamps. Those designed to operate on Alternating Current and those designed to operate on Direct Current.

4.3.1 Operating Voltage Range

The operating voltage range shall be dependent on the manufacturers specified voltage range and voltage type (AC or DC).

4.3.2 Luminous Performance

The luminous efficacy of a light system shall be at least 40 lumens/Watt

4.3.3 Output Waveform Symmetry

The electrical waveform on the Light Emitting Diode (LED) Lamp shall be dependent on the manufacturers specified voltage range and voltage type (AC or DC).

4.3.4 Reverse Polarity Protection

The ballast shall not be damaged when the nominal voltage is applied in a reversed connection and zero current shall flow during this period unless this state is capable of operating the lamp normally for prolonged periods of time without any damage to the lamp.

4.3.5 Open Circuit Protection

Application of power at the nominal voltage after failure or removal of the bulb shall not cause damage to the inverter -ballast.

4.3.6 Over-current Protection

Same as for CFLs (Clause 4.2.6)

4.3.7 Switches

Same as for CFLs (Clause 4.2.7)

4.4 Terminals

The correct type of fitting applicable to the lamp shall be specified by the manufacturer.

Note: input terminals may be provided for the luminary either internally or externally or the equipment may be provided with colour coded flying leads of at least 200 mm in length.

5 TESTING OF LIGHTING DEVICES

Performance of lighting devices shall be in accordance with ZS IEC 60969 (for fluorescent lights) and ZS IEC 62717 (for LEDs)

6 GUARANTEE

A guarantee against faulty workmanship and design for a minimum operating time of 6,000 hours for Fluorescent Lamps and 30,000 hours for LEDs but not less than the period specified by the manufacturer shall be provided.

7 MARKING

Each Lighting Devices fitting shall be clearly and permanently marked in English or any other language alongside English with the following information:

- a. The name and address of the manufacturer or supplier or his trademark;
- b. The model name or number;
- c. The serial number;
- d. operating voltage type and range;
- e. Polarity of each electrical terminal for DC devices;
- f. Power Consumption in Watts

ANNEX A

(Normative)

Information to be Supplied by the Supplier

The manufacturer, supplier or distributor shall provide the following information with each lighting device

- a. The country of manufacture.
- b. operating voltage type and range
- c. Power rating.
- d. Luminosity (lux)
- e. Colour temperature (e.g warm white, cool white, neutral white, off white, yellow, green, red)
- f. Safe disposal information
- g. General safety information
- h. Service life (hours of lighting)