SLOVENSKI STANDARD

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Izmenično napajane elektronske predstikalne naprave za cevaste fluorescenčne svetilke – Tehnične zahteve (IEC 60929:2006)

AC-supplied electronic ballasts for tubular fluorescent lamps - Performance requirements (IEC 60929:2006)

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AC-supplied electronic ballasts for tubular fluorescent lamps - Performance requirements

(IEC 60929:2006)

Ballasts électroniques alimentés en courant alternatif pour lampes tubulaires à fluorescence - Exigences de performances (CEI 60929:2006)

Wechselstromversorgte elektronische Vorschaltgeräte für röhrenförmige Leuchtstofflampen - Anforderungen an die Arbeitsweise (IEC 60929:2006)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 34C/700/FDIS, future edition 3 of IEC 60929, prepared by SC 34C, Auxiliaries for lamps, of IEC TC 34, Lamps and related equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60929 on 2006-02-01.

This European Standard supersedes EN 60929:2004.

The essential change with respect to en 60929:2004 is the introduction of the principle of preheat energy. The main impact of this is on Clause 7 and Annex D.

In this edition, references to IEC 60928 have been replaced by references to IEC 61347-2-3 which, in conjunction with IEC 61347-1, replaces IEC 60928.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2006-11-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2013-02-01

This European Standard makes reference to International Standards. Where the International Standard referred to has been endorsed as a European Standard or a home-grown European Standard exists, this European Standard shall be applied instead. Pertinent information can be found on the CENELEC web site.

Endorsement notice

The text of the International Standard IEC 60929:2006 was approved by CENELEC as a European Standard without any modification.

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Ballasts électroniques alimentés en courant alternatif pour lampes tubulaires à fluorescence – Exigences de performances

AC-supplied electronic ballasts for tubular fluorescent lamps – Performance requirements

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

AC-SUPPLIED ELECTRONIC BALLASTS FOR TUBULAR FLUORESCENT LAMPS – PERFORMANCE REQUIREMENTS

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

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International Standard IEC 60929 has been prepared by subcommittee 34C: Auxiliaries for lamps, of IEC technical committee 34: Lamps and related equipment.

This third edition cancels and replaces the second edition published in 2003 and constitutes a technical revision. The essential change with respect to the second edition is the introduction of the principle of preheat energy. The main impact of this is on clause 7 and annex D.

In this edition, references to IEC 60928 have been replaced by references to IEC 61347-2-3 which, in conjunction with IEC 61347-1, replaces IEC 60928.

The text of this standard is based on the following documents:

FDIS	Report on voting
34C/700/FDIS	34C/711/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

This International Standard covers performance requirements for electronic ballasts for use on a.c. supplies up to 1 000 V at 50 Hz or 60 Hz with operating frequencies deviating from the supply frequency, associated with tubular fluorescent lamps as specified in IEC 60081 and IEC 60901, and other tubular fluorescent lamps for high frequency operation, still to be standardised.

These ballasts are intended to operate lamps at various frequencies including high frequencies and at various lamp powers. Attention is drawn to the fact that operating frequencies below 20 kHz may cause audio noise disturbance, whereas frequencies above 50 kHz may increase radio interference problems.

Some lamps may be specifically designed for high-frequency operation on high-frequency ballasts. Two starting modes, preheat and non-preheat, are described.

NOTE Lamps, only specified for preheat starting may be operated on other types of circuits. The ballast manufacturer should provide test data which shows satisfactory starting and operation similar as the ones stated in Clause 6.

In order to obtain satisfactory performance of fluorescent lamps and electronic ballasts, it is necessary that certain features of their design be properly co-ordinated. It is essential, therefore, that specifications for them be written in terms of measurement made against some common baseline of reference, permanent and reproducible.

These conditions may be fulfilled by reference ballasts. Moreover, the testing of ballasts for fluorescent lamps will, in general, be made with reference lamps and, in particular, by comparing results obtained on such lamps with ballasts to be tested and with a reference ballast.

Whereas the reference ballast for frequencies of 50 Hz or 60 Hz is a self-inductive coil, the high-frequency reference ballast is a resistor because of its independence of frequency and the lack of influence of parasitic capacitance.

AC-SUPPLIED ELECTRONIC BALLASTS FOR TUBULAR FLUORESCENT LAMPS – PERFORMANCE REQUIREMENTS

1 Scope

This International Standard specifies performance requirements for electronic ballasts for use on a.c. supplies up to 1 000 V at 50 Hz or 60 Hz with operating frequencies deviating from the supply frequency, associated with tubular fluorescent lamps as specified in IEC 60081 and IEC 60901 and other tubular fluorescent lamps for high frequency operation.

NOTE 1 Tests in this standard are type tests. Requirements for testing individual ballasts during production are not included.

NOTE 2 There are regional standards regarding the regulation of mains current harmonics and immunity for end-products like luminaires and independent controlgear. In a luminaire, the controlgear is dominant in this respect. Controlgear, together with other components, should comply with these standards.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60081, *Double-capped fluorescent lamps – Performance specifications*

IEC 60669-2-1, *Switches for household and similar fixed electrical installations – Part 2-1: Particular requirements – Electronic switches*

IEC 60901, *Single-capped fluorescent lamps – Performance specifications*

IEC 61347-1, *Lamp controlgear – Part 1: General and safety requirements*

IEC 61347-2-3, *Lamp controlgear – Part 2-3: Particular requirements for a.c. supplied electronic ballasts for fluorescent lamps*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply:

3.1
starting aid
a 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

3.2
ballast lumen factor
blf
ratio of the luminous flux of the lamp when the ballast under test is operated at its rated voltage, to the luminous flux of the same lamp operated with the appropriate reference ballast supplied at its rated voltage and frequency

3.3
reference ballast
special ballast, either inductive for lamps for operation on a.c. mains frequencies, or resistive for 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 standardised conditions. It is essentially characterised 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 this standard.

[IEV .845-08-36, modified]

3.4
reference lamp
lamp selected for testing ballasts which, when associated with a reference ballast, has electrical characteristics which are close to the nominal values as stated in the relevant lamp standard

NOTE Specified conditions are given in Annex C.

3.5
calibration current of a reference ballast
value of the current on which are based the calibration and control of the reference ballast

NOTE Such a current should preferably be approximately equal to the rated current of the lamps for which the reference ballast is suitable.

3.6
total circuit power
total power dissipated by ballast and lamp in combination, at rated voltage and frequency of the ballast

3.7
circuit power factor
λ
power factor of the combination of a ballast and the lamp or lamps for which the ballast is designed

3.8
high power factor ballast
ballast having a circuit power factor of at least 0,85

NOTE 1 The value 0,85 takes into account the distortion of the current waveform.

NOTE 2 For North America, a high power factor is defined as a power factor of at least 0,9.

3.9
high audio-frequency impedance ballast
ballast of which the impedance in the frequency range 250 Hz to 2 000 Hz exceeds the values specified in Clause 13 of this standard

3.10
preheat starting
type of circuit in which the lamp electrodes are brought to emission temperature before the lamp actually ignites

3.11
non-preheat starting
type of circuit which utilises a high open-circuit voltage causing secondary electron emission from electrodes

3.12
pre-start time
for ballasts according to 3.11, period after switching on the supply voltage during which the lamp current is ≤10 mA

4 General notes on tests

4.1 Tests according to this standard are type tests.

NOTE The requirements and tolerances permitted by this standard are based on the testing of a type test sample submitted by the manufacturer for that purpose. In principle this type test sample should consist of units having characteristics typical of the manufacturer's production and be as close to the production centre point values as possible.

It may be expected with the tolerances given in this standard that products manufactured in accordance with the type test sample will ensure compliance with the standard for the majority of the production. However, due to the production spread, it is inevitable that there will sometimes be products outside the specified tolerances. For guidance on sampling plans and procedures for inspection by attributes, see IEC 60410.

4.2 The tests are carried out in the order of the clauses, unless otherwise specified.

4.3 One ballast is submitted to all tests.

4.4 In general, all tests are made on each type of ballast or where a wattage range of similar ballasts is involved, for each rated wattage in the range or on a representative selection from the range as agreed with the manufacturer.

4.5 The tests are made under the conditions specified in Annex A. Lamp data sheets not published in an IEC publication shall be made available by the lamp manufacturer.

4.6 All ballasts specified in this standard shall comply with the requirements of IEC 61347-2-3.

4.7 Attention is drawn to lamp performance standards which contain "information for ballast design"; this should be followed for proper lamp operation; however, this standard does not require the testing of lamp performance as part of the type test approval for ballasts.

5 Marking

5.1 Ballasts shall be clearly marked with the following mandatory marking.

a) Circuit power factor e.g. 0,85.

   If the power factor is less than 0,95 capacitive, it shall be followed by the letter C, e.g. 0,85 C.

The following marking shall also be added, if appropriate:

b) The symbol $\tilde{Z}$ which indicates that the ballast is designed to comply with the conditions for audio-frequency impedance.

5.2 In addition to the above mandatory markings, the following information shall either be given on the ballast or be made available in the manufacturer's catalogue or the like.

a) a clear indication regarding the type of starting, viz. preheat or non-preheat;

b) indication whether a ballast needs a starting aid.

c) ballast lumen factor if different from 1±0,05.

5.3 Non-mandatory information which may be made available by the manufacturer:

a) rated output frequency at rated voltage, with and without lamp operating;

b) limits of the ambient temperature range within which the ballast will operate satisfactorily at the declared voltage (range);

c) total circuit power.

6 General statement

It may be expected that ballasts complying with this standard, when associated with lamps which comply with IEC 60081 or IEC 60901 or other fluorescent lamps for high-frequency operation, will provide satisfactory starting of the lamp at an air temperature immediately around the lamp between 10 °C and 35 °C and operation between 10 °C and 50 °C at voltages within 92 % and 106 % of the rated voltage.

NOTE 1 The electrical characteristics as given on the lamp data sheets of IEC 60081 and IEC 60901, and applying to operation on a reference ballast at rated voltage with a frequency of 50 Hz or 60 Hz, may deviate when operating on a high frequency ballast and the conditions of item b) of 5.3 above.

NOTE 2 In some regions there are laws on EMC for luminaires. The controlgear is also contributing to this EMC behaviour. See Bibliography for reference.

7 Starting conditions

Ballasts shall start lamps without adversely affecting the performance of the lamp when operated according to intended use. An explanation of the starting conditions is given in Annex D.

Compliance is checked by the tests according to 7.1 to 7.3, as appropriate, with the ballast operating at any supply voltage between 92 % and 106 % of its rated value.

7.1 Conditions for ballasts with preheating

Ballasts shall be tested according to the following requirements and in line with the requirements of Clause A.3. The same requirements for preheating also apply to controllable ballasts at starting in any dimming position.

The lamp data sheet provides one substitution resistor $R_{sub(min)}$ which is used with the ballast in order to test its capability to produce the minimum energy according to the lamp data sheet. If the ballast does not provide at least the minimum energy, it has failed. The maximum energy line has to be tested with another substitution resistor $R_{sub(max)}$ which corresponds to the upper energy. If the ballast generates too high energy, it has failed. The value of the second resistor is also given on the lamp data sheet. In cases where no value is given, preliminary values may be obtained from the lamp manufacturer.

7.1.1 Preheat energy

The ballast shall deliver at least the minimum total heating energy E_{min} at t_1 according to the time/energy limits on the relevant lamp data sheets (see Figure 1). Within the interval (t_1, t_2) the total heating energy shall be between E_{min} and E_{max} according to the relevant lamp data sheet (see Figure 1).

The maximum heating energy shall not exceed the limits specified on the relevant lamp data sheet at any time before t_2. This does not apply in the interval (t_1, t_2), if $t_2 - t_1 < 0{,}1$ s.

The absolute minimum preheat time shall be 0,4 s unless otherwise specified on the relevant lamp data sheet.

In order to prevent arcing, the voltage supplied to the substitution resistor should remain below 11 V r.m.s., for $E < E_{min}$.

If a lamp data sheet does not give any energy data for preheating, and the preheat current requirements are not applicable, the lamp manufacturer shall provide appropriate preheat data.

Compliance with the requirements for the cathode preheat current can be tested as follows:

With a non-inductive substitution resistor of the value specified on the relevant lamp data sheet, substituted for each lamp cathode, the ballast shall deliver a minimum and maximum total heating current according to the time/current limits specified on the relevant lamp data sheet. The minimum preheat current i_k is defined as

$$i_k = \sqrt{\frac{a}{t_e} + i_m^2}$$

a: constant (A^2 s) for a specific cathode type
i_m: absolute minimum value of the effective heating current (A) to achieve emission, if application time is of sufficiently long duration (e.g. ≥ 30 s from cold)
t_e: time (s) to emission

NOTE Emission time less than 0,4 s is normally not acceptable because experience has shown that satisfactory cathode preheating is not always achievable in practice.

Values for a and i_m are given on the lamp data sheet.

Measurements are conducted with a non-inductive substitution resistor for testing cathode preheat requirements of the value specified on the relevant lamp data sheet, substituted for each lamp cathode, also in case of two or more lamps simultaneously operated.

7.1.2 Open-circuit voltage

The open-circuit voltage between any pair of substitution resistors shall not exceed the maximum value specified on the lamp data sheet, during the preheat period. After the preheat period it shall be, or rise to a value, not less than the minimum value equal to the ignition voltage as specified on the lamp data sheet.

Where two or more lamps are operated in series or parallel circuits, each position is measured in turn. The positions where not to measure are equipped with reference lamps, the position where to measure is equipped with a pair of substitution resistors for testing open-circuit voltage.

The open-circuit voltage is measured between the substitution resistors and shall comply in all cases with the value specified on the relevant lamp data sheet for **one** lamp.

Voltage peaks shall be smaller or equal to r.m.s. open-circuit voltage as specified in the relevant lamp data sheet times 1,4. Narrow voltage peaks during the first half period of the mains voltage after switching on preheat shall be disregarded when testing controlgear against this subclause.

Measurement is made with an oscilloscope. Measurements are conducted with a non-inductive substitution resistor for testing open-circuit voltages as specified on the relevant lamp data sheet.

The ballast manufacturer provides on request the value of the cathode substitution resistor within the specified range which results in the lowest open-circuit voltage for ignition.

A small d.c. offset of the open circuit voltage does not affect the lamp starting voltage. Negligible values are under consideration.

7.2 Conditions for ballasts without preheating

Ballasts in accordance with definition 3.11 shall be so designed that the cumulated glow discharge periods during starting do not exceed 100 ms when measured with a reference lamp and without any earthed metal parts close by which might act as a starting aid. The glow discharge period is deemed to have finished if the lamp current is at least 80 % of the rated lamp current.

A ballast is deemed to conform with the above requirements when the following conditions are fulfilled.

7.2.1 Open-circuit voltage

Measurement is made with an oscilloscope. With a non-inductive substitution resistor R_C of the value specified on the relevant lamp data sheet, substituted for each lamp cathode (see Figure 2a), the open-circuit voltage shall comply with the value specified on the relevant lamp data sheet.

Where two or more lamps are operated in series or parallel, each position is measured in turn. The positions where not to measure are equipped with reference lamps, the position where to measure is equipped with a pair of cathode substitution resistors.