

Specification for

A.C.-supplied electronic ballasts for tubular fluorescent lamps — Performance requirements

The European Standard EN 60929:1992 has the status of a
British Standard

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National foreword

This British Standard has been prepared by Technical Committee CPL/34/3 (formerly LGL/21) and is the English language version of EN 60929:1992 *A.C.-supplied electronic ballasts for tubular fluorescent lamps — Performance requirements*, and its amendments A1 and A2, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 929:1990 including its corrigendum:1990 and its amendments 1 and 2, published by the International Electrotechnical Commission (IEC).

The foreword of amendment A1 to the EN makes reference to the “date of withdrawal (dow) of conflicting national standards” as 1996-02-15. In this case, the relevant national standard is BS EN 60929:1992, but the date of withdrawal relates only to those parts of the British Standard subject to Amendment No. 1. Certificates and marks will not be awarded after this date with respect to the British Standard not incorporating Amendment No. 1. They will be awarded only to the amended British Standard. However, such certificates and marks already awarded with respect to the British Standard not incorporating Amendment No. 1 may continue to apply for production until 2001-02-15.

Analogous provisions obtain in respect of Amendment No. 2, for which the dow is 1997-04-01 and the expiry date for current approvals is 2001-02-15.

The following print types are used in this standard:

- requirements proper: in roman type;
- *test specifications: in italic type;*
- notes: in smaller roman type.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 32, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

English version

A.C.-supplied electronic ballasts for tubular fluorescent lamps — Performance requirements

(includes amendments A1:1995 + A2:1996)
(IEC 929:1990 + Corrigendum June 1991 + A1:1995 + A1:1996)

Ballasts électroniques alimentés en courant alternatif pour lampes tubulaires à fluorescence

Prescriptions de performances
(inclut les amendements A1:1995 + A2:1996)
(CEI 929:1990 + corrigendum
juin 1991 + A1:1995 + A1:1996)

Wechselstromversorgte elektronische Vorschaltgeräte für röhrenförmige Leuchtstofflampen

Anforderungen an die Arbeitsweise
(enthält Änderungen A1:1995 + A2:1996)
(IEC 929:1990 + Corrigendum
Juni 1991 + A1:1995 + A1:1996)

This European Standard was approved by CENELEC on 1992-03-24. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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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 CENELEC questionnaire procedure, performed for finding out whether or not the International Standard IEC 929:1990 and its corrigendum of June 1991 could be accepted without textual changes, has shown that no common modifications were necessary for the acceptance as European Standard.

The reference document was submitted to the CENELEC members for formal vote and was approved by CENELEC as EN 60929 on 24 March 1992.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1993-03-01
- latest date of withdrawal of conflicting national standards (dow) 1993-03-01

For products which have complied with the relevant national standard before 1993-03-01, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 1998-03-01.

Annexes designated “normative” are part of the body of the standard. Annexes designated “informative” are given only for information. In this standard, Annex D is informative and Annex A, Annex B, Annex C and Annex ZA are normative.

Foreword to amendment A1

The text of document 34C(CO)276, future amendment 1 to IEC 929:1990, prepared by SC 34C, Auxiliaries for discharge lamps, of IEC TC 34, Lamps and related equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 to EN 60929:1992 on 1995-02-15.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1996-02-15
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 1996-02-15

For products which have complied with EN 60929:1992 before 1996-02-15, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 2001-02-15.

Foreword to amendment A2

The text of document 34C/331/FDIS, future amendment 2 to IEC 929:1990, 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 amendment A2 to EN 60929:1992 on 1996-07-02.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1997-04-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 1997-04-01

Introduction

This 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 81 and IEC 901, and other tubular fluorescent lamps for high frequency operation, still to be standardized.

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 The possibility exists for operation of lamps designed for preheat starting on circuits of the non preheat type. Lamps specified for operation on both types of circuits may appear in IEC 81 or lamp manufacturers will have to authorize such operation of their lamps.

In order to obtain satisfactory performance of fluorescent lamps and electronic ballasts, it is necessary that certain features of their design be properly coordinated. It is essential, therefore, that specifications for them be written in terms of measurement made against some common baseline of reference, which must be reasonable, 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 independency of frequency and the lack of influence of parasitic capacitance.

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 81 and IEC 901 and other tubular fluorescent lamps for high frequency operation.

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

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 81:1984, *Tubular fluorescent lamps for general lighting service (Amendment No. 1:1987, Amendment No. 2:1988)*.

IEC 410:1973, *Sampling plans and procedures for inspection by attributes*.

IEC 555-2:1982, *Disturbances in supply systems caused by household appliances and similar electrical equipment — Part 2: Harmonics (Amendment No. 2:1988)*.

IEC 901:1987, *Single-capped fluorescent lamps — Safety and performance requirements*.

IEC 928:1990, *A.C.-supplied electronic ballasts for tubular fluorescent lamps – General and safety requirements*.

3 Definitions

For the purposes of this International Standard, the following definitions apply:

3.1 starting aid

starting aid can be either a conductive stripe affixed to the outer surface of a lamp, or a conductive plate which is spaced within an appropriate distance from a lamp. A starting aid can only be effective when it has an adequate potential difference from one end of the lamp

3.2 ballast lumen factor

ratio of the light output of the lamp when the ballast under test is operated at its rated voltage, compared with the light output of the same lamp operated with the appropriate reference ballast supplied at its rated voltage and frequency

3.3 reference ballast

special ballast designed for the purpose of providing comparison standards for testing ballasts and for selecting reference lamps. 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 this standard

3.4 reference lamp

lamp selected for testing ballasts which, when associated with a reference ballast under specified conditions, has electrical characteristics which are close to the nominal values as stated in the relevant lamp standard for that particular type of lamp

3.5 calibration current of a reference ballast

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

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 (symbol 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 0,85¹⁾

NOTE The value of power factor takes into account the effect of the distortion of the current waveform.

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 14 of this standard

3.10 low-distortion type ballast

ballast of which the harmonic content complies with the more severe requirements of 12.1 of this standard

3.11 preheat starting

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

3.12 non-preheat starting

type of circuit which utilizes a high open-circuit voltage causing field emission from electrodes

3.13 pre-start time

for ballasts according to 3.12, 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 410.

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 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 928.

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 leading, it shall be followed by the letter C, e.g. 0,85 C.

The following markings shall also be added, if appropriate:

¹⁾ For North America, high power factor is defined as a power factor of at least 0,9.

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

c) The symbol H which indicates that the ballast is not of the low distortion type.

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.

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) ballast lumen factor and total circuit power in combination.

6 General statement

It may be expected that ballasts complying with this standard, when associated with lamps which comply with IEC 81 or IEC 901 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 The electrical characteristics as given on the lamp data sheets of IEC 81 and 901, 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.

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 (informative).

Compliance is checked by the tests according to 7.1 to 7.4, as appropriate, with the ballast operating at any supply voltage between 92 % and 106 % of its rated value.

NOTE Preheat current or voltage requirements also apply to controllable ballasts in any dimming position.

7.1 Ballasts for current-controlled preheat starting mode

For ballasts of this category the following requirements apply. The tests shall be carried out in accordance with the requirements of Annex A, clause A.4.

7.1.1 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 total effective heating current according to the time/current limits specified on the relevant lamp data sheets. (See Figure 1).

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

The maximum effective heating current shall not exceed the limits specified on the relevant lamp data sheet at any time t .

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

If the current through the substitution resistor, as specified in 7.1.1, is interrupted before the minimum specified voltage for lamp starting has been reached, the voltage rise to minimum starting voltage shall take place within not more than 0,1 s. (See Figure 2.1).

If the voltage rise takes more than 0,1 s, the current through the substitution resistor shall not fall below the absolute minimum value specified. (See Figure 2.2).

The crest factor of the open-circuit voltage shall not exceed 1,8. Even very narrow voltage peaks which do not influence the r.m.s. value shall not occur during the minimum preheat period.

7.2 Ballasts for voltage-controlled preheat starting mode

Ballasts of this type shall provide proper cathode preheating voltage, cathode operating voltage, and lamp starting voltage. Limiting values and appropriate substitution resistors are specified on the relevant lamp data sheets in IEC 81 and IEC 901.

Lamps with either low resistance cathodes or high resistance cathodes may be operated by this method.

7.2.1 Ballasts shall deliver r.m.s. cathode heating voltage, within the limits specified on the relevant lamp data sheet, to the specified substitution resistors, when rated supply voltage is applied.

It is permitted to exceed the maximum cathode voltage limit provided the maximum cathode current is in accordance with the requirements for current-controlled preheating.

The minimum application time of the cathode heating voltage shall be 0,4 s.

Dependent upon lamp data sheet requirements, the cathode heating voltage after 0,4 s may be:

- a) applied continuously during operation;
- b) reduced to a lower level;
- c) reduced to zero.

7.2.2 Ballasts shall provide the lamp starting voltages specified on the relevant lamp data sheet for:

- a) r.m.s. voltage across the lamp, and
- b) peak voltage to starting aid, if required.

Starting requirements for various series circuits may be specified. For operation of lamps in parallel circuits the relevant single lamp requirement shall be provided for each lamp.

The starting voltages may be available simultaneously with the cathode preheating voltage or they may be elevated to those levels after 0,4 s elapsed time. Any voltage applied before 0,4 s shall be lower than the level that would cause starting of the lamp or shall be in accordance with the values given for current-controlled preheating.

7.3 Ballasts for non-preheat starting mode

Ballasts in accordance with definition 3.12 shall be so designed that the cumulative 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 nominal lamp current.

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

7.3.1 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 3a), the open-circuit voltage shall comply with the value specified on the relevant lamp data sheet.

Where two lamps are operated in series, the open-circuit voltage delivered to each lamp shall be determined in turn, by substituting a reference lamp in one lamp position and substitution resistors, of the value specified on the relevant lamp data-sheet, in place of the electrodes in the other lamp position.

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

NOTE In the case of additional cathode heating during the starting process, lower values may be sufficient provided the glow discharge period does not exceed 100 ms.

7.3.2 Ballast impedance test

With a non-inductive lamp substitution resistor R_L of the value specified on the relevant lamp data sheet, substituted for the lamp and a non-inductive resistor R_c of the value specified on the relevant lamp data sheet, substituted for each lamp cathode, (see Figure 3b), and at 92 % of the rated voltage, the ballast shall deliver a current not less than the minimum value specified on that data sheet.

7.3.3 Cathode current

Ballasts of the non-preheat start type may supply some cathode heating during the starting process.

The cathode current, if any, shall not exceed the maximum value specified on the relevant lamp data sheet.

The measurement is carried out with a substitution resistor R_i (see Figure 3c), the value of which is calculated as follows:

$$R_i = 11 (2,1 I_n)^{-1}$$

where

I_n is the nominal value of the lamp operating current.

7.4 Starting aid and distances

Lamps operated with electronic ballasts complying with this standard may require a starting aid as specified in IEC 81. The open-circuit voltage and voltage to starting aid (if required), during preheat and starting, shall be within the limits specified in the information for ballast design on the relevant lamp data sheet.

8 Operating conditions

8.1 At rated voltage, the ballast lumen factor shall not be less than 95 % of the value declared by the manufacturer.

If the declared lumen factor of the ballast is less than 0,9, evidence shall be given that the performance of lamps operated on that ballast is not impaired. A relevant test is under consideration.

8.2 At rated voltage, the total circuit power shall be not more than 110 % of the value declared by the manufacturer, when the ballast is operated with a) reference lamp(s).