

Specification for

General and safety requirements for D.C. supplied electronic ballasts for tubular fluorescent lamps

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British Standard

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National foreword

This British Standard has been prepared under the direction of the Electrical Illumination Standards Policy Committee and is the English language version of EN 60924:1991 *D.C. supplied electronic ballasts for tubular fluorescent lamps. General and safety requirements* including Amendment A1:1994, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 924:1990 and its Amendment No. 1:1993 published by the International Electrotechnical Commission (IEC) with the same title.

The foreword of the EN makes reference to “date of withdrawal (dow) of conflicting national standards” as “1994-10-01”. In this case the relevant national standard is BS EN 60924 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 1999-10-01.

This British Standard supersedes BS 5717 which will be withdrawn.

The foreword and preface of IEC 924:1990 which do not form part of the text of EN 60924 have been quoted in National appendix NA.

Annexes designated “normative” are part of the body of the standard. Annexes designated “informative” are given for information only. In this standard, Annex ZA is normative. National appendix NA, National appendix NB and National appendix NC are designated “informative”.

Cross-references. Details of International Standards quoted in this British Standard for which there are identical or technically equivalent British Standards are given in National appendix NC.

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 36, 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.

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English version

D.C. supplied electronic ballasts for tubular fluorescent lamps General and safety requirements

(include amendment A1:1994)
(IEC 924:1990)

Ballasts électroniques alimentés en courant continu pour lampes tubulaires à fluorescence
Prescriptions générales et prescriptions de sécurité

(inclut l'amendement A1:1994)
(CEI 924:1990)

Gleichstromversorgte elektronische Vorschaltgeräte für röhrenförmige Leuchtstofflampen — Allgemeine und Sicherheits-Anforderungen

(enthält Änderungen A1:1994)
(IEC 924:1990)

This European Standard was approved by CENELEC on 10 December 1990. 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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Foreword

The CENELEC questionnaire procedure, performed for finding out whether or not the International Standard IEC 924:1990 could be accepted without textual changes, has shown that no CENELEC 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 60924 on 10 December 1990.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1991-09-01
- latest date of withdrawal of conflicting national standards (dow) 1991-09-01

For products which have complied with the relevant national standard before 1991-09-01, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 1996-09-01.

Annexes designated “normative” are part of the body of the standard. In this standard, Annex ZA is normative.

Endorsement notice

The text of the International Standard IEC 924:1990 was approved by CENELEC as a European Standard without any modification.

Foreword to amendment A1

At the request of the CENELEC Technical Committee TC 34Z, Luminaires and associated equipment, amendment 1:1993 to the International Standard IEC 924:1990 was submitted to the CENELEC Unique Acceptance Procedure (UAP) in April 1993 for acceptance as a European Standard.

The text of the International Standard was approved by CENELEC as amendment A1 to EN 60924 on 8 December 1993.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1994-10-01
- latest date of withdrawal of conflicting national standards (dow) 1994-10-01

For products which have complied with EN 60924:1991 before 1994-10-01, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 1999-10-01.

Annexes designated “normative” are part of the body of the standard. In this standard, Annex ZA is normative.

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Introduction

This standard covers general and safety requirements for d.c. supplied electronic ballasts for tubular fluorescent lamps, formerly called “transistorized ballasts”. Performance requirements for these ballasts are the subject of IEC Publication 925.

NOTE Safety requirements ensure that electrical equipment constructed in accordance with these requirements does not endanger the safety of persons, domestic animals, or property when properly installed and maintained and used in applications for which it was intended.

This standard refers only to d.c. supplied electronic ballasts for use with lamps which are internationally the most in demand.

Each section in this standard specifies the safety requirements for one specific field of application.

Section 1. General requirements

1 Scope

This standard specifies general and safety requirements for electronic ballasts for use on d.c. supplies, having rated voltages not exceeding 250 V, associated with fluorescent lamps complying with IEC Publication 81.

This standard also specifies electronic ballasts for lamps which are not yet standardized.

It does not specify independent ballasts.

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

2 Definitions

2.1

d.c. supplied electronic ballast

d.c. to a.c. inverter using semiconductor devices which may include stabilizing elements for supplying power to one or more fluorescent lamps

2.2

rated voltage range

range of supply voltage over which the ballast is intended to be operated

2.3

design voltage

voltage declared by the manufacturer to which all the ballast characteristics are related. This value shall be not less than 85 % of the maximum value of the rated voltage range

2.4

working voltage (symbol U)

highest d.c. or r.m.s. a.c. voltage which may occur across any insulation, transients being neglected, in open-circuit conditions or during lamp operation at rated voltage

2.5

live part

conductive part which may cause an electric shock in normal use. The neutral conductor shall, however, be regarded as a live part

2.6

rated maximum operating temperature of a ballast case (symbol t_c)

highest permissible temperature which may occur on the outer surface (at the indicated place, if marked) under normal operating conditions and at the rated voltage or maximum of the rated voltage range

2.7

type test

test or 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 specification

2.8

type test sample

sample consisting of one or more similar units submitted by the manufacturer or responsible vendor for the purpose of a type test

3 General requirements

Ballasts shall be so designed and constructed that in normal use they operate without danger to the user or surroundings.

In general, compliance for ballasts and other elements is checked by carrying out all the tests specified.

4 General notes on tests

a) *Tests according to this standard are type tests.*

NOTE The requirements and tolerances permitted by this standard are related to the testing of a type-test sample submitted for that purpose. Compliance of the type-test sample does not ensure compliance of the whole production of a manufacturer with this safety standard.

Conformity of production is the responsibility of the manufacturer and may include routine tests and quality assurance in addition to type testing.

b) *Unless otherwise specified, the tests are carried out at an ambient temperature between 10 °C and 30 °C.*

c) *The tests are carried out in the order of the clauses unless otherwise specified.*

d) *Where ballasts are intended for use from battery supplies it is permissible to substitute a d.c. power source other than a battery, provided that the source impedance is equivalent to that of a battery.*

NOTE A non-inductive capacitor of appropriate rated voltage and with a capacitance of at least 50 µF, connected across the supply terminals of the unit under test normally provides a source impedance simulating that of a battery.

e) *Tests to meet the safety requirements for d.c. supplied electronic ballasts for emergency lighting (see Section 6) are made under the conditions specified in Appendix A.*

f) *The type test is carried out on one sample consisting of one or more items submitted for the purpose of the type test.*

Certain countries require three ballasts to be tested and in such cases, if more than one ballast fails, then the type is rejected.

If one ballast fails, the test is repeated using three other ballasts and all of these shall comply with the test requirements.

5 Category

D.C. supplied electronic ballasts are classified according to their intended application:

- a) general lighting;
- b) public transport lighting;
- c) aircraft lighting;
- d) emergency lighting.

6 Marking

6.1 Ballasts shall be clearly marked with the following mandatory markings:

- a) Mark or origin (trade mark, manufacturer's name or name of the responsible supplier).
- b) Model number or type reference of the manufacturer.
- c) Wiring diagram indicating the position of terminals. In the case of ballasts not having terminals, a clear indication shall be given on the wiring diagram of the significance of the code used for the connecting wires.
- d) Rated voltage range.
- e) Open-circuit voltage (for warning only, not to be tested).
- f) Symbol for earthing as applicable, see Clause 9. This symbol shall not be placed on screws or other easily removable parts.
- g) The value of t_c .

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

- a) Heat sink(s) required additional to the ballast.
- b) Whether the ballast is proof against supply voltage polarity reversal.
- c) Marking according to category.
- d) Design voltage.
- e) Rated supply current range for the maximum permissible lamp load and for the rated voltage range.

NOTE Ballasts designed to operate various numbers and ratings of lamps draw different supply currents at the same supply voltage according to the constitution of their load.

f) Rated lamp wattage or the designation as indicated on the lamp data sheet of the type(s) of lamp(s) for which the ballast is designed. If the ballast is to be used with more than one lamp, the number and wattages of each lamp shall be indicated.

g) A declaration if the ballast does not rely upon the luminaire enclosure for protection against accidental contact.

h) A declaration of the cross-section of conductors for which the terminals, if any, are suitable.

Symbol: relevant value(s) in mm² followed by a small square . . . □.

6.3 Marking shall be durable and legible

Compliance is checked by inspection and by trying to remove the marking by rubbing lightly, for 15 s each, with two pieces of cloth, one soaked with water and the other with petroleum spirit.

The marking shall be legible after the test.

NOTE The petroleum spirit used should consist of a solvent hexane with a content of aromatics of maximum 0.1 volume percentage, a kauri-butanol value of 29, an initial boiling-point of approximately 65 °C, a dry-point of approximately 69 °C and a density of approximately 0.68 g/cm³.

Section 2. General safety requirements

7 Scope

This section specifies general safety requirements applicable to all types of d.c. supplied electronic ballasts. The particular safety requirements for each application are specified in the subsequent sections of this standard.

8 Terminals

Screw terminals shall comply with Section 14 of IEC Publication 598-1.

Screwless terminals shall comply with Section 15 of IEC Publication 598-1.

9 Provision for earthing

9.1 Protective earth (ground), graphical symbol 417C-IEC-5019

Any earth terminal shall comply with the requirements of Clause 8. The clamping means shall be adequately locked against loosening and it shall not be possible to loosen the clamping means by hand. For screwless terminals, it shall not be possible to loosen the clamping means unintentionally.

Earthing of ballasts by fixing the ballasts to earthed metal is permitted. However, if a ballast has an earthing terminal, this terminal shall only be used for earthing the ballast.

All parts of an earth terminal shall be such as to minimize the danger of electrolytic corrosion resulting from contact with the earth conductor or any other metal in contact with them.

The screw or the other parts of the earth terminal shall be made of brass or other metal no less resistant to corrosion, or a material with a non-rusting surface and at least one of the contact surfaces shall be bare metal.

Compliance is checked by inspection, by manual test and by the tests of Clause 8.

Conductors for protective earthing provided by tracks on printed circuit boards shall be tested as follows:

A current from an a.c. source of 25 A is passed for 1 min between the earthing terminal or earthing contact via the track on the printed board and each of the accessible metal parts in turn.

After the test, the requirement of IEC 598-1, subclause 7.2.3 shall apply.

9.2 Functional earth (ground), graphical symbol 417C-IEC-5017

A functional earthing terminal denotes a terminal to which are connected parts which may be necessary to connect to earth for reasons other than safety.

NOTE In some instances, starting aids adjacent to the lamp(s), are connected to one of the output terminals but need not be connected to the earth on the supply side.

9.3 Frame or chassis, graphical symbol 417C-IEC-5020

10 Creepage distances and clearances

Creepage distances and clearances shall be not less than the values given in Table IA, and Table IB, as appropriate, unless otherwise specified in clause 14.

The contribution to the creepage distance of any groove less than 1 mm wide shall be limited to its width.

Any air gap of less than 1 mm shall be ignored in computing the total air path.

NOTE Creepage distances are distances in air, measured along the surface of insulation.

A metal enclosure shall have an insulating lining if, in the absence of such a lining, the creepage distance or clearance between live parts and the enclosure would be smaller than the value prescribed below.

Ballasts, where the components are so encapsulated in a self-hardening compound bonded to the relevant surfaces that clearances do not exist, are not checked.

Printed boards are exempt from the requirements of this clause because they are tested in accordance with clause 14.

Table IA — Minimum distances for a.c. (50 Hz/60 Hz) sinusoidal voltages

Minimum distances (mm)	R.M.S. working voltage not exceeding (V)					
	50	150	250	500	750	1 000
1) Between live parts of different polarity and 2) Between live parts and accessible metal parts which are permanently fixed to the ballast, including screws or devices for fixing covers or fixing the ballast to its support — Creepage distances insulation PTI ≥ 600 < 600 — Clearances	0,6 1,2 0,2	1,4 1,6 1,4	1,7 2,5 1,7	3 5 3	4 8 4	5,5 10 5,5
3) Between live parts and a flat supporting surface or a loose metal cover, if any, if the construction does not ensure that the values under 2) above are maintained under the most unfavourable circumstances — Clearances	2	3,2	3,6	4,8	6	8
NOTE 1 PTI (proof tracking index) in accordance with IEC 112. NOTE 2 In the case of creepage distances to parts not energized or not intended to be earthed where tracking cannot occur, the values specified for material with PTI ≥ 600 apply for all materials (in spite of the real PTI). For creepage distances subjected to working voltages of less than 60 s duration, the values specified for materials with PTI ≥ 600 apply for all materials. NOTE 3 For creepage distances not liable to contamination by dust or moisture, the values specified for material with PTI ≥ 600 apply (independent of the real PTI).						

Table IB — Minimum distances for non-sinusoidal pulse voltages

Minimum distances	Rated pulse voltage (peak kV)						
	2,0	2,5	3,0	4,0	5,0	6,0	8,0
Clearances (mm)	1,0	1,5	2	3	4	5,5	8

For distances subjected to both sinusoidal voltage as well as non-sinusoidal pulses, the minimum required distance shall be not less than the highest value indicated in either table.

Creepage distances shall not be less than the required minimum clearance.

11 Protection against accidental contact with live parts

11.1 Ballasts which do not rely upon the luminaire enclosure for protection against electric shock, see Sub-clause 6.2 g), shall, when installed as in normal use, be sufficiently protected against accidental contact with live parts as specified in Appendix B.

Lacquer and enamel are not deemed to be adequate protection or insulation for the purpose of this requirement.

Parts providing protection against accidental contact shall have adequate mechanical strength and shall not work loose in normal use. It shall not be possible to remove them without the aid of a tool.

Compliance is checked by inspection, by a manual test and if necessary, by a test with the standard test finger according to Figure 1 of IEC Publication 529. This finger is applied in every position, if necessary with a force of not more than 10 N, an electrical indicator being used to show contact with live parts. It is recommended that a lamp be used for the indication of contact and that the voltage be not less than 40 V.

11.2 Ballasts incorporating capacitors of total capacitance exceeding 0.5 μF shall be constructed so that the voltage at the ballast terminations does not exceed 50 V, 1 min after disconnection of the ballast from a source of supply at rated voltage.

12 Moisture resistance and insulation

Ballasts shall be moisture resistant. They shall not show any appreciable damage after being subjected to the following test.

The ballast is conditioned for 48 h in an enclosure containing air with a relative humidity maintained between 91 % and 95 %. The temperature of the air at all places where samples can be located is maintained within 1 °C of any convenient value t between 20 °C and 30 °C.

Before being placed in the enclosure, the sample is brought to a temperature between t and $(t + 4)$ °C

Insulation shall be adequate:

- a) between the input terminals bonded together and all exposed metal parts, the output terminals being open-circuit;
- b) between the output terminals bonded together and all exposed metal parts, the input terminals being open-circuit.

Before the insulation test, visible drops of water, if any, are removed by means of blotting paper.

Immediately after the moisture treatment, the insulation resistance is measured with a d.c. voltage of approximately 500 V 1 min after application of the voltage. Ballasts having an insulating cover or envelope are wrapped with metal foil.

The insulation resistance shall be not less than 2 M Ω

In the case of ballasts having an internal connection or component between one or more input or output terminals and any exposed metal parts, such a connection is removed during this test.

13 Electric strength

Immediately after the measurement of the insulation resistance, the ballasts shall withstand an electric strength test for 1 min applied between the parts specified in Clause 12.

The test voltage of substantially sine-wave form, having a frequency of 50 Hz or 60 Hz shall correspond to the values in Table II. Initially not more than half the specified voltage is applied, the voltage is then raised rapidly to the prescribed value.

Table II — Electric strength test voltage

Working voltage (U)	Test voltage (V)
Up to and including 42 V	500
Above 42 V up to and including 1 000 V	$2 U + 1\,000$