British Standard

BRITISH STANDARD

BS EN
50311:2003

Railway applications — Rolling stock — D.C. supplied electronic ballasts for lighting fluorescent lamps

The European Standard EN 50311:2003 has the status of a British Standard

ICS 29.140.99

National foreword

This British Standard is the official English language version of EN 50311:2003.

The UK participation in its preparation was entrusted to Technical Committee GEL/9, Railway electrotechnical applications, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled "International Standards Correspondence Index", or by using the "Search" facility of the *BSI Electronic Catalogue* or of British Standards Online.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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

This British Standard, was published under the authority of the Standards Policy and Strategy Committee on 30 July 2003

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 37 and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

Amendments issued since publication

Amd. No.	Date	Comments

ISBN 0 580 42313 1

EUROPEAN STANDARD **EN 50311**

NORME EUROPÉENNE

EUROPÄISCHE NORM June 2003

ICS 29.140.99

English version

Railway applications – Rolling stock – D.C. supplied electronic ballasts for lighting fluorescent lamps

Applications ferroviaires – Matériel roulant – Ballasts électroniques à courant continu pour lampes fluorescentes d'éclairage

Bahnanwendungen – Schienenfahrzeuge – Gleichstromversorgte elektronische Vorschaltgeräte für Leuchtstofflampen

This European Standard was approved by CENELEC on 2002-12-03. 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.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 50311:2003 E

Foreword

This European Standard was prepared by SC 9XB, Electromechanical material on board of rolling stock, of the Technical Committee CENELEC TC 9X, Electrical and electronic applications for railways.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50311 on 2002-12-03.

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) 2003-12-01

- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2005-12-01

Annexes designated “informative” are given for information only.
In this standard, Annexes A to H are informative.

Contents

Page

Introduction **4**

1 Scope **4**

2 Normative references **4**

3 Definitions **6**
3.1 General terms 6
3.2 Lamps and characteristics 7

4 Classification **8**

5 Characteristics **8**
5.1 Rated voltages 8
5.2 Overvoltages 8
5.3 Type of fluorescent lamps 9

6 Product information **9**
6.1 Nature of information 9
6.2 Marking 10
6.3 Instructions for storage, installation operation and maintenance 10

7 Normal service conditions **10**
7.1 Temperature 10
7.2 Other conditions 10

8 Constructional and performance requirements **10**
8.1 Constructional requirements 10
8.2 Performance requirements 11
8.3 Safety requirements 15

9 Tests **16**
9.1 Test conditions 16
9.2 Kinds of tests 16
9.3 Verification of constructional and performance requirements 18

Annex A (informative) **Types of lamps** **27**

Annex B (informative) **Electronic ballast for lamps up to 40 W** **28**

Annex C (informative) **Electronic ballast for lamps up to 40 W** **29**

Annex D (informative) **Electronic ballast for lamps up to 15 W** **30**

Annex E (informative) **Electronic ballast for lamps up to 10 W** **31**

Annex F (informative) **Electronic ballast for lamps up to 10 W** **32**

Annex G (informative) **Basic schematic diagrams** **33**

Annex H (informative) **Correspondence with EN 60924 requirements** **36**

Introduction

Environmental conditions and general requirements for electronics for rolling stock are given by the following standards EN 50125-1 and EN 50155.

This standard has been developed specifically for railway applications, to supplement the current standards. It covers general, safety and performance requirements in addition to or in place of those contained in EN 60925 and EN 60924.

NOTE 1 When applied unchanged the clauses of EN 60924 are either referred in this standard or introduced into if they are short texts.

NOTE 2 When a clause of EN 60924 applies with changes or is replaced by more specific requirements generally a short note explains the difference or the reason for that.

NOTE 3 Annex H gives clause by clause correspondence between EN 60924 and this standard.

NOTE 4 EN 60924 will be replaced by EN 61347-1, EN 61347-2-4, EN 61347-2-5, EN 61347-2-6 and EN 61347-2-7.

1 Scope

This standard specifies the performance and constructional requirements, and associated tests, for d.c. supplied electronic ballasts used to supply fluorescent lamps for lighting on railway rolling stock. Its requirements replace those of EN 60925 for all railway rolling stock applications and precise and complete those of EN 60924 for the specific needs of railway rolling stock applications.

This standard applies to electronic ballasts

- supplying pre-heated cathode fluorescent lamps without integrated starters, tubular or single capped, according to EN 60081 and EN 60901 respectively,
- having a single and non adjustable luminous flux level.

It does not apply to electronic ballasts supplying non pre-heated cathode lamps and/or lamps with integrated starters.

2 Normative references

This European Standard incorporates by dated or undated references, provisions from other publications. These normative references are cited at the appropriate place in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 45545-5 [1)]		Railway applications - Fire protection on railway vehicles Part 5: Fire safety requirements for electrical equipment including that of trolley buses, track guided buses and magnetic levitation vehicles
EN 50121-3-2	2000	Railway applications - Electromagnetic compatibility Part 3-2: Rolling stock - Apparatus
EN 50124-1		Railway applications - Insulation coordination Part 1: Basic requirements - Clearances and creepage distances for all electrical and electronic equipment
EN 50125-1		Railway applications - Environmental conditions for equipment Part 1: Equipment on board rolling stock

[1)] At draft stage.

EN 50153		Railway applications - Rolling stock - Protective provisions relating to electrical hazards
EN 50155	1995 [2)]	Railway applications - Electronic equipment used on rolling stock
EN 55015	1996 [3)]	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
EN 60068-1	1994	Environmental testing Part 1: General and guidance (IEC 60068-1:1998 + corr. Oct. 1998 + A1:1992)
EN 60068-2-1	1993	Part 2: Tests - Tests A: Cold (IEC 60068-2-1:1990)
EN 60068-2-2	1994	Part 2: Tests - Tests B: Dry heat (IEC 60068-2-2:1974 + IEC 60068-2-2A:1976)
EN 60068-2-30	1999	Part 2: Tests - Test Db and guidance: Damp heat, cyclic (12 + 12 hour cycle) (IEC 60068-2-30:1980 + A1:1985)
EN 60077-1	2002	Railway applications - Electric equipment for rolling stock Part 1: General service conditions and general rules (IEC 60077-1:1999, modified)
EN 60081		Double-capped fluorescent lamps - Performance specifications (IEC 60081)
EN 60417-1	1999	Graphical symbols for use on equipment - Part 1: Overview and application (IEC 60417-1:1998)
EN 60529	1991	Degrees of protection provided by enclosures (IP code) (IEC 60529:1989)
EN 60901	1996	Single-capped fluorescent lamps - Performance specifications (IEC 60901:1996)
EN 60924	1991[4)]	D.C. supplied electronic ballasts for tubular fluorescent lamps - General and safety requirements (IEC 60924:1990)
EN 60925	1991	D.C. supplied electronic ballasts for tubular fluorescent lamps - Performance requirements (IEC 60925:1989)
EN 60927	1996	Auxiliaries for lamps - Starting devices (other than glow starters) - Performance requirements (IEC 60927:1996)
EN 61373		Railway applications - Rolling stock equipment - Shock and vibration tests (IEC 61373)
IEC 60050-811		International electrotechnical vocabulary – Chapter 811: Electric traction
ISO 2859-1		Sampling procedures for inspection by attributes - Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection

2) A new edition of EN 50155 was published in 2001 (dow = 2003-08-01).

3) A new edition of EN 55015 was published in 2000 (dow = 2003-08-01).

4) To be superseded by EN 61347-1:2001, EN 61347-2-4:2001, EN 61347-2-5:2001, EN 61347-2-6:2001 and EN 61347-2-7:2001 (dow = 2003-11-01).

3 Definitions

For the purposes of this standard, the following definitions apply.

NOTE Most of the definitions listed in this clause are taken unchanged from the International Electrotechnical Vocabulary (IEC 60050) or from an European Standard. When this is the case, the reference is given in brackets with the title. Where relevant, the IEV chapter reference is indicated by the first group of 3 figures.

3.1 General terms

3.1.1
nominal value
a suitable approximate quantity value used to designate or identify a characteristic of a component, device or equipment
[IEC 60050 (811-11-01)]

3.1.2
rated value
a quantity value assigned, generally by a manufacturer, for a specified operating condition of a component, device or equipment
[IEC 60050 (811-11-02)]

3.1.3
rated voltage range
range of supply voltage over which the electronic ballast is intended to be operated
[EN 60924]

3.1.4
rated voltage
voltage declared by the manufacturer to which all the electronic ballast characteristics are related and which is not less than 85 % of the maximum value of the rated voltage range

NOTE The term of « rated voltage » generally used in railway applications has been preferred to « design voltage » defined in EN 60924.

3.1.5
rated maximum operating temperature of a ballast case (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
[EN 60924]

3.1.6
type test
a test of one or more devices made to a certain design to show that the design meets certain specifications
[IEC 60050 (811-10-04)]

3.1.7
routine test
a test to which each individual device is subjected during or after manufacture to ascertain whether it complies with certain criteria
[IEC 60050 (811-10-05)]

3.1.8
sampling test
a test on a number of devices taken at random from a batch
[IEC 60050 (811-10-06)]

3.1.9
investigation test
a special test of an optional character carried out in order to obtain additional information
[IEC 60050 (811-10-07)]

3.1.10
exposed conductive part
any metallic or other form of conductive material which is not energised except in case of failure, and which may be accessible to touch
[EN 50153]

3.1.11
protective bonding
equipotential connection for protective purpose
[EN 50153]

3.2 Lamps and characteristics

3.2.1
d.c. supplied electronic ballast
electronic ballast
d.c. to a.c. inverter using semi-conductor devices which may include stabilising elements for supplying power to one or more fluorescent lamps
[EN 60924]

NOTE 1 For the need of this standard d.c. supplied electronic ballast includes starter and ballast functions.

NOTE 2 The term of « electronic ballast » is more commonly used than d.c. supplied electronic ballast and will be used in this standard.

3.2.2
started fluorescent lamp
a fluorescent lamp when a current is crossing the space between the two cathodes

3.2.3
lighted fluorescent lamp
a fluorescent lamp emitting light that can be observed visually, uniformly distributed within the space between the two cathodes. A lamp is not lighted when the light emitted is only localised around the cathodes

3.2.4
extinguished fluorescent lamp
a fluorescent lamp emitting no light, when visually observed

NOTE A lamp which emits light around the cathode(s) is not considered as extinguished.

3.2.5
switching cycle
the complete power cycle between extinguished, started, lighted and extinguished states

4 Classification

Electronic ballasts are classified according to parameters determined by the performance required and the mechanical characteristics. These parameters which may be chosen or specified by the purchaser are the following:

- nominal supply voltage;
- number and type (power) of lamps;
- temperature operating class;
- bare or housed ballast;
- size and fixations;
- wiring diagram;
- type of terminals.

Other requirements (e.g. special length cables, burn-in, etc.) shall be defined by the purchaser.

5 Characteristics

5.1 Rated voltages

Rated voltages and rated voltage ranges defined in 7.1.5 of EN 50155 for each of the nominal voltage are given in Table 1.

Table 1 - Rated voltages and rated voltage ranges according to nominal voltages

Nominal voltages	Rated voltages	Rated voltage ranges	
		Minimum	Maximum
V	V	V	V
24	27,6	16,8	32
26,5 [a]	30,5	18,5	35
36	41,4	25,2	48
48	55,2	33,6	64
72	82,8	50,4	96
96	110,4	67,2	128
110	126,5	77	147
NOTE For maintenance of existing rolling stock, other nominal voltage values and widened ranges should be agreed between user and manufacturer.			
[a] The nominal voltage of 26,5 V is due to special combinations of battery cells in use.			

5.2 Overvoltages

Electronic ballasts shall withstand supply overvoltages as defined in EN 50155.

5.3 Type of fluorescent lamps

The manufacturer shall declare the types of lamps for which the ballast is designed and, from these types, those which shall be considered as reference for design and used for testing the ballast.

Informative Annex A lists the most commonly used types of lamps in the railway field.

6 Product information

6.1 Nature of information

The following information, which includes that required by EN 60924 when appropriate, shall be given by the manufacturer.

6.1.1 Identification

- manufacturer's name or trademark;
- mode number or type reference of the manufacturer;
- modification status given by letters or figures (e.g. A, B, C ... to tick off).

6.1.2 Characteristics

- rated voltage and voltage range;
- all possible wiring diagrams showing and identifying the terminals;
- open circuit voltage;
- temperature operating class;

  NOTE Temperature operating class has been preferred to rated maximum operating temperature (t_c), (see 8.2.1.5).

- symbol for earthing (protective bonding to the car body) as applicable; graphic symbol  EN 60417-1;
- reference to this standard (instead of category defined in Clause 5 of EN 60924);
- type and nominal value of replaceable fuse, if any.

6.1.3 Other characteristics and information for installation

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

- nominal working frequency lamp operation and its range;
- mechanical characteristics;
- weight;
- installation recommendation such as
  - type of cable and wiring between electronic ballast and lamp,
  - type of terminals, etc.
- rated input withstand voltage;
- supplementary information if required.

6.2 Marking

All relevant information, as detailed in 6.1.1 and 6.1.2, shall be marked on the nameplate, away from the base plate and preferably on top of the electronic ballast. Marking shall be indelible and easily legible. Test of compliance is describe in 7.2 of EN 60924.

The symbol for earthing (protective bonding) shall be marked as close as possible to the earth terminal or one of the bolted fixation, if they are used as such. It may be marked away from the nameplate but shall not be marked on screws or other easily removable parts. It shall be visible after installation.

For traceability, markings shall also contain at least one of the following:

- the manufacturing serial number;
- the manufacturing date;
- the code of manufacturing.

It is preferred that all markings are placed on a nameplate. The nameplate shall not be conductive, if only stuck.

6.3 Instructions for storage, installation operation and maintenance

Only instructions needed to comply with the requirements shall be given by the manufacturer. Any other instructions are at the manufacturer's discretion.

7 Normal service conditions

Where relevant, requirements of Clause 2 and Clause 3 of EN 50155, which refers to EN 50125-1, shall apply with the following additions.

7.1 Temperature

The ambient air temperature surrounding the electronic ballast and the lamp(s) shall be

- either -25 °C to +55 °C for an operating class T1 of EN 50155,
- or -40 °C to +55 °C for an operating class T2 of EN 50155,
- or -25 °C to +70 °C for an operating class T3 of EN 50155,
- or -40 °C to +70 °C for an operating class Tx of EN 50155.

The ambient temperature for storage purposes shall be between -40 °C and +85 °C.

7.2 Other conditions

NOTE Electronic ballasts are always installed inside the vehicle and therefore protected from external conditions such as rain, snow, hail, ice, etc., but they may be subject to the moisture from condensation.

8 Constructional and performance requirements

8.1 Constructional requirements

Construction shall comply with the constructional requirements given in Clause 6 and Clause 7 of EN 50155, where relevant, with the following additions.

8.1.1 Dimensions and wiring diagram

For maintenance purposes and in order to achieve interchangeability with existing units, it is recommended that the electronic ballasts comply with dimensions and wiring diagrams given in one of the informative Annexes B to H, depending on the type of unit.

Electronic ballasts without housing shall comply with the requirements agreed between the purchaser and the manufacturer.

8.1.2 Terminals

Type of terminals to be provided for the ballasts may be chosen by the purchaser.

Screws, current-carrying parts and mechanical connections shall comply with the requirements of Clause 8 and Clause 15 of EN 60924 when appropriate.

Electronic ballasts without housing shall comply with the requirements agreed between the purchaser and the manufacturer.

8.1.3 Provisions for repair

Electronic ballast shall be designed such that all necessary access for diagnosis and repair is possible without damage or undue disturbance to the components or wiring.

The enclosure shall provide the necessary protection against the environmental influences. It shall be possible to dismantle and repair or replace the components. Potting to provide additional protection is not allowed.

8.1.4 Clearance and creepage distances

Clearance and creepage distances shall comply with EN 50124-1 considering

- pollution degree PD1 for housed printed circuit board and PD2 for external parts,
- overvoltage category OV2.

The values shall not be lower than those required by Clause 10 and 14.1 of EN 60924.

8.1.5 Protection

In order to maintain operability of the lighting equipment, the electronic ballast shall isolate itself from the circuit in case of an internal short-circuit and shall include

- either a calibrated fuse fitted as a replaceable component,
- or three printed tracks used as fuses which can be changed over during repair; then they shall not be used to protect against incorrect connection of polarity (see 8.2.2.1).

The protection calibration shall be, in case of short-circuit, such as the peak current value is limited to 20 times the continuous current I_r at the rated voltage.

NOTE The general protection value of the lighting circuit, chosen by the customer, should be at least equal to 25 times the current absorbed by one electronic ballast.

8.1.6 Inrush current

The peak inrush current which may occur at the time of switch-on, measured in specified conditions of low impedance source, shall be less than 20 times the continuous current I_r of the electronic ballast supplied at the rated voltage. Before 1,5 ms, the current shall be at its permanent value.

NOTE A more restrictive limit of inrush current may be specified by the customer.

8.2 Performance requirements

8.2.1 Electronic ballast parameters in accordance with lamps characteristics

All requirements given hereafter are only applicable for appropriate type(s) of lamp(s) for which the electronic ballast is designed, and the characteristics which comply with the requirements of their relevant standard.

8.2.1.1 *Current wave form supplied to lamps*

The current wave form supplied to the lamps shall be such that the electronic ballast complies with the electromagnetic compatibility requirements (see 8.2.3.4). In any case the ratio between the peak value and the r.m.s value shall not exceed 1,7.

8.2.1.2 *Luminous flux - Luminance*

At the ambient air temperature of 22 °C ± 5 K, the lamp supplied by the electronic ballast at the rated voltage shall emit a luminous flux at least equal to those emitted by the same lamp supplied by any 50 Hz a.c. inductive ballast, the voltage of which being set to obtain the nominal power in the lamp.

8.2.1.3 *Efficiency*

At the ambient air temperature of 22 °C ± 5 K, the power supplied to the lamp(s) by the electronic ballast at the rated voltage shall be at least equal to 0,75 time the power absorbed by the electronic ballast input.

8.2.1.4 *Frequency*

The operating frequency shall be at least 18 kHz, irrespectively of the working conditions considered as possible in this standard.

NOTE If needed to avoid EMC problems, the purchaser can either fix on special request the frequency range in which the electronic ballast operates or exclude a special frequency range.

8.2.1.5 *Temperature*

The electronic ballast shall withstand, without requiring any additional heat sink, the whole temperature range for which it is designed irrespective of the supply voltage within the rated voltage range.

The electronic ballast shall start the lamp for all temperatures equal to or higher than -5 °C irrespective of the applied supply voltage within the rated voltage range.

In addition, for operating classes T2 and Tx, the electronic ballast shall start the lamp at temperatures equal to or higher than -25 °C irrespective of the applied supply voltage between the nominal voltage and the maximum voltage.

No damage shall occur to electronic ballast or to the lamp(s) at temperatures outside the range required for lamp starting.

Reduced lighting performance is accepted when the temperature around the lamp is less than -5 °C.

8.2.2 Exceptional conditions of use

In addition to normal conditions of use, electronic ballasts are required to endure the following exceptional conditions without any damage to the electronic ballasts or to the lamps.

8.2.2.1 *Polarity reversal protection*

Electronic ballasts shall be provided with protection against an incorrect polarity of the supply voltage at the input terminals. A continuous supply with incorrect polarity shall not damage the unit. During this period the electronic ballast shall withstand the overvoltage requirements without failure.

If any fuses are allowed to be blown then the fuse shall be replaceable without removing the electronic ballast. Following the correct polarity connection and the replacement of the fuse, the electronic ballast shall operate properly.

8.2.2.2 *Changing of lamps*

Electronic ballasts shall be able to withstand the effects of removing one or more lamps, at any voltage within the rated voltage range.

They shall be able to light one or more new lamps, as soon as fitted, at the minimum temperature of 15 °C and at the rated voltage. At lower temperature and voltage values, the lighting of the new lamp may require a new switching cycle.

8.2.2.3 *Abnormal function of the lamp*

Electronic ballasts shall be able to withstand the effects of any failure of a lamp or lamps such as

- non lighting of one or more lamps,
- lamps with one or both filaments cut,
- abnormal variation of filament resistance,
- lamps functioning as a diode.

8.2.2.4 *Output voltage without lamps*

Independent of either being on load or off load, the insulation of cables connecting the lamps to the ballast shall not be exposed to excessive dielectric stress.

At the rated voltage and 5 s after switching on, electronic ballasts peak voltages between any cable and car body shall be less than 800 V.

8.2.2.5 *Short-circuit*

Electronic ballasts shall be able to withstand short-circuits of every filament.

8.2.2.6 *Gradually decreasing of supply voltage*

The electronic ballasts shall not be damaged when the supply falls or remains below the lowest limit value of the rated voltage range, irrespective of the rate of the decreasing voltage.

8.2.2.7 *Pre-heating current*

The electronic ballasts shall allow short-term cycles of lighting/extinguishing without shortening lamp working lives. This shall be achieved with a time delay for the starting process including the time which is required to heat the filaments before starting or an equivalent system.

The limiting values of effective heating current shall comply with the requirements of Clause B.4 of EN 60927.

8.2.3 Electronic ballast design requirements

8.2.3.1 *Leakage current*

The leakage current between each input connection and metallic housing, measured in specified conditions, shall not exceed 0,7 mA.

8.2.3.2 *Ripple factor of input current*

The ripple factor of the current measured according to the conditions of 9.3.2.2 shall not be greater than 10 %.

Ripple factor of the current is calculated as (%) = $100 \times \frac{(I_{\max} - I_{\min})}{(I_{\max} + I_{\min})}$.

8.2.3.3 *Ripple factor of input voltage*

Due to battery charging, the d.c. supply voltage has a pulsating voltage. The electronic ballast shall operate from a supply voltage affected by a ripple factor not greater than 15 %.

Ripple factor of a voltage is calculated as (%) = $100 \times \frac{(U_{\max} - U_{\min})}{(U_{\max} + U_{\min})}$.

8.2.3.4 *Electromagnetic compatibility (EMC)*

Emission and immunity requirements apply to the electronic ballast including wiring and lamps as recommended by the manufacturer. Therefore, radio disturbance characteristics shall be considered on the complete electrical lighting equipment (luminaries).

Emission shall comply with Clause 8 of EN 50121-3-2 considering Table 4 and Table 6 limits. In addition Table 3 limits apply to the output when the electronic ballast is considered alone.

Immunity shall comply with Clause 9 of EN 50121-3-2 considering Table 7 and Table 9 limits.

8.2.3.5 *Magnetic effects*

Electronic ballasts shall be designed to be fastened on a metal plate. Additionally, any metallic part installed at distance of 25 mm or less from the electronic ballast shall not have any influence on its performance.

NOTE Electronic ballasts may be installed at distances of less than 25 mm from a metallic part if, after manufacturer's agreement, it has been proven that there is no influence on performance.

8.2.3.6 *Predicted reliability*

Where a reliability level is required, then 4.1 of EN 50155 applies. The component reliability data shall be agreed between the manufacturer and the purchaser at the time of tender and the calculation shall be based on ground mobile environmental operation and on ambient temperature of 40 °C.

8.2.3.7 *Burn-in*

The standard does not deal with burn-in. At the time of tender, the purchaser may require from the manufacturer to submit electronic ballasts to a systematic burn-in process at the end of the manufacturing process. The burn-in test should reflect the specified operating conditions.

8.2.4 Installation requirements

All performance deterioration due to the installation and which are not covered by the following requirements of this standard shall be subject of a special agreement.

8.2.4.1 *Quality of cables*

The purchaser shall verify that the cable used between electronic ballast and lamps can withstand the output voltage without lamps (conditions given in 8.2.2.4).

8.2.4.2 *Cross section area of cables*

The minimum cross section area for cables used between electronic ballast and lamps shall be 0,5 mm^2.

8.2.4.3 *Length of wiring between electronic ballast and lamps*

The length of each pair of cables supplying lamps including that between two lamps connected in series shall not be more than 3 m. Nevertheless, after manufacturer's agreement, longer cables may be used according to the capacity provided by the insulating material.

8.2.4.4 *Distance between lamp and metallic support*

Electronic ballasts are designed to supply tubular fluorescent lamps mounted along a metallic support which is bonded to the car body in order to ensure a starting under satisfactory conditions. No other device shall be placed near the lamps to assist starting.

The metallic support of 40 mm width shall be located at the following maximum distance from the tubular lamp surface:

- 20 mm for lamps with a diameter of 25 mm to 38 mm;
- 7 mm for lamps with a diameter of 15 mm.

This clause is not relevant for single capped lamps.

8.2.4.5 *Protective bonding to the car body*

For railway application bonding to the car body makes both protective earth and functional earth.

Exposed conductive parts of electronic ballasts which do not comply with double insulation design (see 2.3 of IEC 60536) shall be bonded to the car body to achieve human safety by protection against electrical hazards. This can be obtained satisfactorily

- by wiring on a special terminal,
- or by the fixations on the metallic plate itself bonded. These fixations shall then be considered as having the same performance as terminals, i.e. the fixation areas shall be of good conductivity,
- or by wiring on one of the fixations which is to be considered as a terminal.

All parts of a bonding terminal shall be such as to minimise the risk of electrolytic corrosion resulting from contact with the bonding conductor or any other metal in contact with them.

The screw or other parts of the bonding terminal shall be made of brass or other metal with a good resistance against corrosion, or a material with a non-rusting surface and at least one of the contact surfaces shall be bare metal.

8.2.4.6 *Environment*

The electronic ballasts shall be fitted in such a manner that in any case the surrounding air temperature is not greater than those given in 7.1 according to the temperature operating class.

8.3 Safety requirements

Electronic ballasts shall be designed to operate in normal use without causing any danger to the user or surroundings.

The electronic ballasts shall comply with requirements of EN 60924. However this standard refers to the applicable clauses with relevant changes necessary for railway applications, if any; and it refers to clauses of EN 60924 which shall apply, if appropriate, even if no reference is made.

Protection against accidental contact with live parts shall comply with Clause 11 of EN 60924.

Protection of housing electronic ballasts shall comply with code IP40 according to EN 60529.

Electronic ballasts shall not be impaired when they are submitted to overvoltages defined in EN 50155.

Electronic ballasts shall be designed according to fire requirements given in EN 45545-5.

NOTE For information Annex H gives clause by clause correspondence between EN 60924 and this standard, with necessary comments when useful.

9 Tests

9.1 Test conditions

9.1.1 Environmental conditions

Unless otherwise specified, all tests shall be performed under normal atmospheric conditions in accordance with Clause 5 of EN 60068-1.

Before testing, the electronic ballasts shall be placed under these conditions for 24 h.

The effective atmospheric conditions in the test room shall not be subjected to major or rapid variations during a test period. These conditions shall be recorded in test report.

9.1.2 Other conditions

The electronic ballast placed horizontally shall be normally earthed (bonded) but shall not be fastened on a metallic support.

The tubular lamps shall be placed along a metallic plate at the relevant maximum distance required in 8.2.4.4. The metallic plate is connected to the bonded pole of the electronic ballast supply.

Electronic ballast performance shall be measured with new fluorescent lamps. A fluorescent lamp is considered as new when it has been aged during 100 h with an inductive ballast supplied at 230 V - 50 Hz and has less than 1 000 h operation.

Unless otherwise specified, the electronic ballast shall be loaded with a maximum number of lamps so that all output circuits are connected during tests.

If appropriate, tests required by EN 60924 may be mixed with those of this standard to be carried out simultaneously.

9.2 Kinds of tests

9.2.1 Type tests

Type tests are intended to check that a product complies with its specification. They are carried out on ten random samples taken from a mass produced batch consisting of at least fifty items. Before testing the electronic ballast samples shall be submitted to a systematic burn-in of 96 h at 70 °C with the maximum voltage supply and the maximum number of lamps.

NOTE Tests carried out on prototype in order to prove the design or the ability of the manufacturer to design a product is not considered as type tests. Type tests validate both design and manufacturing process.

Type tests are grouped together in 5 sequences as shown in Table 2. For each sequences, the tests shall be carried out in the order listed.

The ten samples are submitted to sequences as follows:

- 4 items are submitted to sequences 1 and 2;
- 2 items are submitted to sequences 1 and 3;
- 2 items are submitted to sequences 1 and 4;
- 1 item is submitted to sequences 1 and 5;
- 1 item is submitted to sequences 1, 2 and 5.

Results to be obtained are given in the relevant subclauses of 9.3 and 9.4.

Table 2 - Type tests

Test designation	Clause reference	Number of items tested
Sequence 1		10
Visual examination	9.3.1.1	
Marking	9.3.1.2	
Weight	9.3.1.3	
Lighting	9.3.1.4	
Efficiency	9.3.1.5	
Consumption	9.3.1.6	
Luminous flux	9.3.1.7	
Dielectric test	9.3.1.8	
Sequence 2		5
Inrush current	9.3.2.1	
Ripple factor of input current	9.3.2.2	
Current wave form supplied to lamps	9.3.2.3	
Frequency	9.3.2.4	
Gradually decreasing of supply voltage	9.3.2.5	
Sequence 3		2
Leakage current	9.3.3.1	
Endurance	9.3.3.2	
Pre-heating current	9.3.3.3	
Sequence 4		2
Output voltage without lamps	9.3.4.1	
Changing lamps	9.3.4.2	
Abnormal function of the lamp	9.3.4.3	
Electromagnetic compatibility (EMC)	9.3.4.4	
Overvoltage withstand	9.3.4.5	
Polarity reversal	9.3.4.6	
Short-circuit	9.3.4.7	
Internal protection	9.3.4.8	
Sequence 5		2
Damp heat test	9.3.5.1	
Dry heat test	9.3.5.2	
Cold test	9.3.5.3	
Vibration test	9.3.5.4	
Shock test	9.3.5.5	
Fire behaviour	9.3.5.6	

9.2.2 Routine tests

Routine tests are designed to check the invariability of technical characteristics and are carried out on every production batch.

They are carried out after burn-in if a specific one is required in manufacturing process (see 8.2.3.7).

The routine tests list is given by Table 3.

NOTE Acceptance tests carried out at the time of delivery are stated between manufacturer and customer. These tests are chosen amongst the routine tests. Acceptance criteria and acceptance quality level according ISO 2859-1 are also stated

Table 3 - Routine tests

Test designation	Clause reference
Visual examination	9.3.1.1
Marking	9.3.1.2
Lighting	9.3.1.4
Consumption	9.3.1.6
Luminous flux (or lamp current)	9.3.1.7
Dielectric test	9.3.1.8
Frequency	9.3.2.4
NOTE If engineering and statistical analyses show that routine test are not required, sampling test may be made instead after agreement between the manufacturer and the user. The number of items tested should be stated according to the expected acceptance quality level (AQL).	

9.2.3 Investigatory tests

Investigatory tests may be done as an extension of type tests. Their purpose is to give additional information on the electronic ballast characteristics. They shall be agreed at contract stage and carried out at the purchaser's request.

9.3 Verification of constructional and performance requirements

Unless otherwise required all tests shall be carried out in the test conditions defined in 9.1.

9.3.1 Sequence 1

9.3.1.1 *Visual examination*

Electronic ballasts shall not reveal faults such as scratches, scores marks of impact, etc. that are visible to persons with normal or corrected sight.

In addition, requirements of 8.1.1 to 8.1.5 shall be checked during type tests.

9.3.1.2 *Marking*

Electronic ballasts shall satisfy the requirements given in 6.2.

9.3.1.3 *Weight*

Weight shall be that given in manufacturer's data sheets.

9.3.1.4 *Lighting*

The electronic ballast being supplied at the minimum voltage of the rated voltage range shall light up the fluorescent lamps. This is checked visually.

9.3.1.5 *Efficiency*

With the electronic ballast being supplied at its rated supply voltage, the efficiency is calculated as the ratio between the sum of power supplied to all the lamps required and the power absorbed by the electronic ballast.

The value shall comply with 8.2.1.3.

9.3.1.6 *Consumption*

When supplied at the rated supply voltage, the current absorbed by the electronic ballast shall not be greater than necessary to supply all lamps taking into account an efficiency of 0,75 for the ballast.

For type tests the current shall be measured after the electronic ballast is supplied for 1 h with the rated voltage.

9.3.1.7 *Luminous flux*

The test is performed at the ambient air temperature of 22 °C ± 5 K.

The method consists of comparing the luminous flux emitted after 15 min by the same lamp supplied either by an inductive ballast or by the electronic ballast.

Firstly, the luminous flux of the lamp is measured in the centre of the lamp when supplied at its rated power, this is achieved by setting of the 50 Hz a.c. supply voltage.

Secondly, the inductive ballast is replaced by the electronic ballast to be tested, supplied at the rated voltage, and the luminous flux is measured in the same conditions as previously.

The second measurement shall not be less than the first one.

9.3.1.8 *Dielectric test*

For dielectric test, ballasts shall be placed on a metallic plate and ballasts with insulating housing shall be wrapped with a conductive foil.

The test is carried out with a d.c. voltage applied gradually in 10 s and maintained during 60 s ± 5 s. For routine tests the full voltage duration is reduced to 5 s.

The test voltage shall be applied

- case 1: between input circuit against output circuit(s) connected together to the metallic plate (protective bonding),
- case 2: between output circuit(s) connected together against the metallic plate (protective bonding).

In both cases all terminals of the same circuit (input or output) shall be short-circuited.

The dielectric test voltage values are given in Table 4.

The test may also be carried out with an a.c. voltage, the peak value being equal to the d.c. value.

No insulation breakdown of the test voltage and no flashover shall occur during the test and the leakage current shall be less than 1 mA.

Table 4 - Dielectric test voltage values

Nominal voltage of electronic ballast V	D.C. test voltage values	
	Case 1 V	Case 2 V
24 - (26,5)	500	2 000
36 - 48	700	2 000
72 - 96 - 110	1 200	2 000
NOTE Values are in accordance with EN 50124-1 considering - overvoltage category OV2 for case 1, - and overvoltage category OV1 for case 2.		

9.3.2 Sequence 2

9.3.2.1 *Inrush current*

The electronic ballast is connected, with a quick closing switch, to a voltage source whose internal impedance is represented by a capacitor of 10 000 μF in accordance with Figure 1.

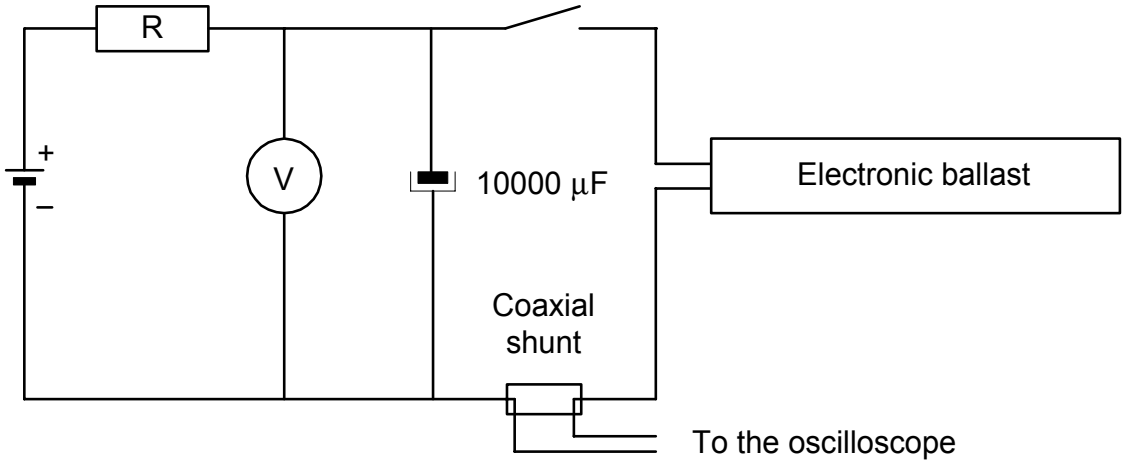


Figure 1 - Test circuit

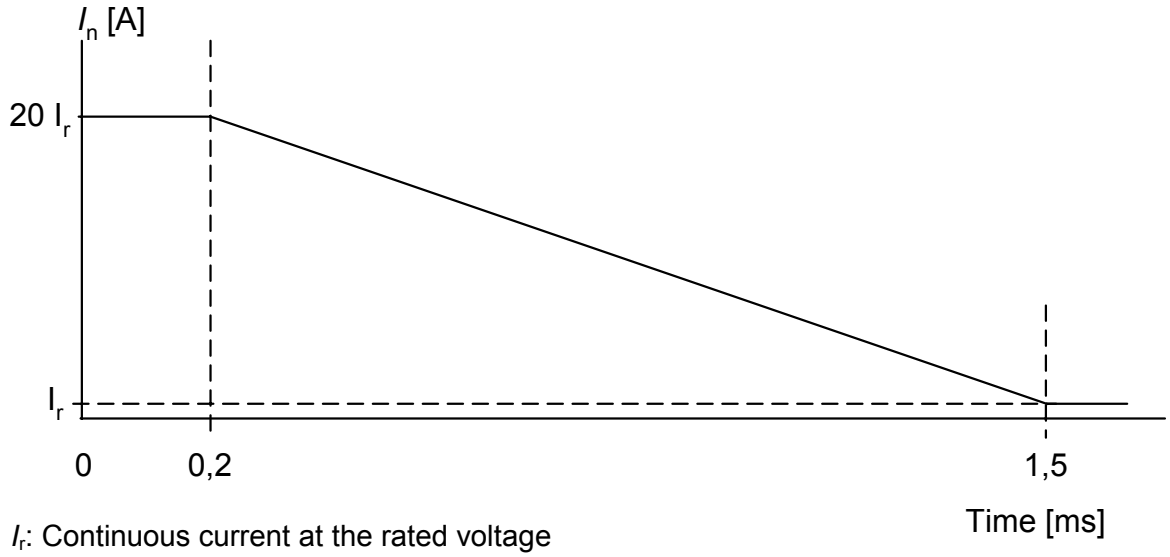
A suitable passband measuring device shall be used to record the current absorbed when the switch closes. The length of each cable made of copper conductors of 1,5 mm^2 cross section area between the electronic ballast and the source shall be equal to 3 m and shall be as straight as possible.

The circuit defined by Figure 1 should also be used for the test required by Clause 4d of EN 60924.

Five measurements shall be made with the capacitor voltage being equal to the rated voltage.

The instantaneous current value shall not exceed the curve given by Figure 2.

NOTE An appropriate curve may be used if a specific condition has been required (see note of 8.1.6).



I_r: Continuous current at the rated voltage

Figure 2 - Current limiting curve

9.3.2.2 *Ripple factor of input current*

The electronic ballast is supplied by the source defined by Figure 1.

The test consists of evaluating the maximum value of the a.c. component of the current absorbed by the electronic ballast.

9.3.2.3 *Current wave form supplied to lamps*

When supplied at the rated voltage, the ratio between the peak value and the r.m.s. value of the current with which the electronic ballast supplies the fluorescent lamps shall not exceed 1,7.

9.3.2.4 *Frequency*

The electronic ballast is supplied at any voltage, within the relevant voltage range given in 5.1. The frequency of the voltage supplying the fluorescent lamps is measured when the electronic ballast is fully loaded and after removing lamps one by one, successively.

Frequency shall be checked during all tests where the electronic ballast is supplied irrespective of the voltage, environment and load conditions.

The frequency shall comply with the requirement of 8.2.1.4.

9.3.2.5 *Gradually decreasing of supply voltage*

The electronic ballast is supplied at the minimum value of its rated voltage range. The voltage is then reduced to zero in equal steps of 0,1 time the rated voltage, the voltage at each step being maintained for 15 min.

It is visually checked during the test that the lamps are extinguished.

At the end of the test the electronic ballast is supplied at the rated voltage, all lamps shall then light up.

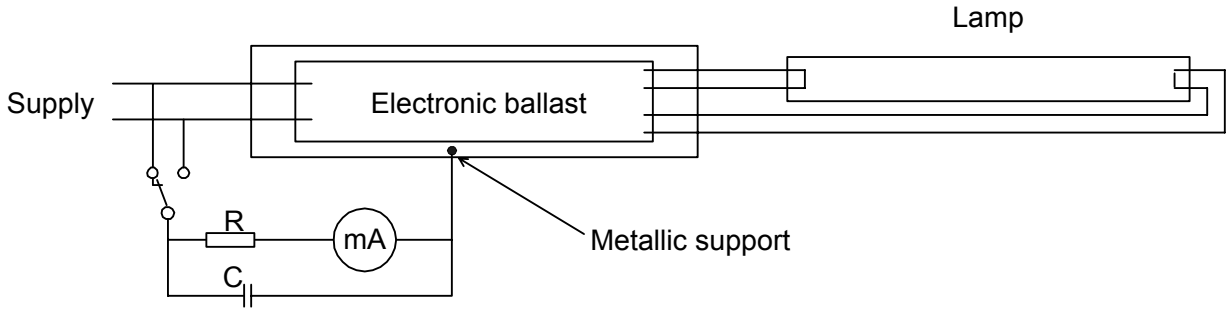
9.3.3 Sequence 3

9.3.3.1 *Leakage current*

The electronic ballast being supplied at the rated voltage, the leakage current shall be measured between each input connections and the metallic support on which the ballast is fitted. The electric circuit is as shown in Figure 3.

The test shall be carried out with lamps as well as without lamps.

The leakage currents measured shall be lower than 0,7 mA.



R = 2000 Ω ± 100 Ω C = 112 nF ± 6 nF

Figure 3 - Circuit for leakage current measurement

9.3.3.2 *Endurance*

The test shall be performed at an ambient air temperature of 22 °C ± 5 K.

The electronic ballast alternatively supplies three identical loads consisting of maximal number of lamps. The loads are switched over during the off period of the switching cycle.

Any fluorescent lamp which fails during the test shall be immediately replaced.

The switching cycle is such that the switching on time is at least 5 s and the switching off time is at least 10 s.

When supplied at the rated voltage, the electronic ballast shall endure 300 000 switching cycles.

At the end of the test, the electronic ballast shall still start the lamps as agreed, at the minimum and maximum values of the voltage range and the number of lamps replaced during the test shall not be more than a third of the total number of lamps.

9.3.3.3 *Pre-heating current*

Pre-heating current time, before lighting, shall be measured successively at the minimum, rated and maximum voltages after a switching off period of longer than 30 s. The measured values shall be within 0,4 s and 2 s.

When supplied at the rated voltage, the electronic ballast shall be submitted to ten lighting cycles consisting of 10 s “on” followed by 2 s “off”. The pre-heating time shall not vary by more than 10 % of the first measurement.

9.3.4 Sequence 4

9.3.4.1 *Output voltage without lamps*

The steady state output voltages shall be measured when the electronic ballast, fitted on a metallic plate, is supplied at the rated voltage, using appropriate means.

The measurements shall be made between every filament circuits and metallic plate.

Peak values of the voltages shall be less than 800 V.

9.3.4.2 *Changing lamps*

This test shall be carried out at the ambient air temperature of 22 °C ± 5 K.

The electronic ballast being supplied at the rated value, every possible combinations of removal of one or several lamps, including the different types if any, shall be tested.

Each test combination shall be maintained for 30 min. After each one, the electronic ballast, full loaded, shall operate again and all lamps shall light up.

9.3.4.3 *Abnormal function of the lamp*

NOTE These are performance tests which may be carried out in addition to those of EN 60924 relating to safety.

Test A - Lamp broken

The lamps are connected in such manner that filaments are normally supplied but that current cannot flow between them. Lamp filaments may also be simulated by equivalent resistors. The electronic ballast shall be supplied with the maximum value of the voltage range for 1 h.

After the test the electronic ballast is normally loaded and supplied at the rated voltage, then the lamp shall light up.

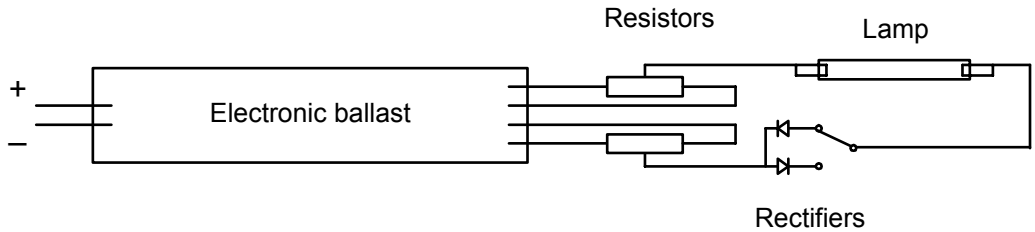
Test B - Cathode deactivated (rectifying effect)

A resistor shall be connected in place of each lamp cathode. The resistor value shall be derived from the value of nominal operational current of the lamp prescribed in the relevant standard - or the value declared by the manufacturer if none is given in the standard - and determined with the following equation:

$$R = \frac{11}{2{,}1 \times I_n}\ \Omega$$

where I_n is nominal operational current of the lamp.

The lamp shall be connected to the midpoints of the appropriate resistors according to Figure 4. The rectifier polarity shall be chosen so as to give the most unfavourable operating conditions. If necessary, the lamp shall be started using a suitable starting device.



Rectifier characteristics:

$U_{RRM} \geq 3\ 000$ V $\quad I_R \leq 10\ \mu$A $\quad I_F \geq 3$ times the lamp current

$t_{IT} \leq 500$ ns (measured with $I_F = 0{,}5$ A and $I_R = 1$ A to $I_R = 0{,}25$ A)

Figure 4 - Circuit for test B: Cathode deactivated (rectifying effect)

9.3.4.4 *Electromagnetic compatibility (EMC)*

The ballast shall meet the requirements given in 8.2.3.4.

The emission test shall be carried out with test methods and test set up given in EN 55015.

9.3.4.5 *Overvoltage withstand*

This test shall be carried out according to 10.2.6 of EN 50155 with the following changes:

- the ambient air temperature is 22 °C ± 5 K;
- the electronic ballast is supplied at the rated voltage;
- the test with wave form H is replaced by electromagnetic compatibility test (see 9.3.4.4).

9.3.4.6 *Polarity reversal*

The electronic ballast shall be supplied at the maximum value of the rated voltage range.

The electronic ballast shall be connected so that the supply voltage positive polarity is connected to negative input and vice versa.

The full voltage is applied instantaneously and maintained for 1 h.

After the test, the electronic ballast shall be normally connected to the lamps and supplied at its rated voltage.The lamps shall light up, after fuse replacement if necessary.

9.3.4.7 *Short-circuit*

One lamp is removed from the circuit and the two terminals corresponding to one filament supplying are short circuited. The electronic ballast shall be supplied at the maximum value of the voltage range for 1 h.

After the test, the electronic ballast shall be normally connected to the lamps and supplied at the rated voltage. The lamps shall light up.

The test shall be repeated for each filament, unless the manufacturer agrees to carry out the test on all filaments simultaneously.

9.3.4.8 *Internal protection*

This test is not applicable to standardised replaceable fuses which shall comply with their product standard.

The test shall be carried out on a bare printed board circuit normally fitted in its housing if any, with a soldered strap making a short-circuit downstream of the printed circuit fuse. The input circuit terminals shall be connected to the source described in 9.3.2.1 through a standard cartridge fuse for domestic and similar purposes (National standard).The fuse rating shall be the next highest value to the figure equal to 25 times the maximum input current given in the manufacturer data sheet.

After closing the circuit only the printed circuit fuse shall be blown without other damage to adjacent components or environment.

9.3.5 Sequence 5

9.3.5.1 *Damp heat test*

This test shall be carried out to demonstrate both compliance with Clause 12 of EN 60924 and performance requirements of this standard.

The de-energised electronic ballast shall be submitted to test Db variant 2 of EN 60068-2-30 with the following conditions:

- severity:
  - temperature: 55 °C ± 1 K;
  - number of cycles: 2;
- intermediate checking and inspection:
  - consumption between 1 h and 1,5 h after the second cycle starting, compliance to 9.3.1.6;
  - lighting just before the end of each cycle with compliance to 9.3.1.4;
- final checking and measurements:
  - dielectric test according to 9.3.1.8;
  - lighting according to 9.3.1.4;
  - visual examination according to 9.3.1.1.

The electronic ballast shall not fail during the test and no deterioration shall appear after the test.

9.3.5.2 *Dry heat test*

The electronic ballast shall be submitted to the test Bd of EN 60068-2-2 with the following conditions:

- severity:
  - temperature: 40 °C ± 1 K for operating class T1;
    35 °C ± 1 K for operating class T2;
    45 °C ± 1 K for operating class T3; or
    50 °C ± 1 K for operating class Tx;
- intermediate checking and inspection:
  - the electronic ballast is permanently supplied at the maximum value of the voltage range;
  - temperature of hottest components are checked to make sure that temperature-rises do not exceed the limits specified in EN 50155 for electronic components and IEC 60077-1 for other parts;
- final checking and measurements:
  - dielectric test according to 9.3.1.8;
  - lighting according to 9.3.1.4;
  - visual examination according to 9.3.1.1.

The electronic ballast shall not fail during the test and no deterioration shall appear after the test.

9.3.5.3 *Cold test*

The test comprises different stages which shall be applied successively for the minimum temperature to withstand and for the minimum temperature for starting of the lamps.

The electronic ballast and the lamps are submitted to the test Ad of EN 60068-2-1 with the following conditions:

- severity:
  - temperature: -25 °C ± 1 K for operating classes T1 and T3; or
    -40 °C ± 1 K for operating classes T2 and Tx;
  - duration: 2 h for operating classes T1 and T3;
    3 h for operating classes T2 and Tx.
- intermediate checking and inspection:
  - after 1 h a lighting test shall be carried out at the rated voltage. Light up of the lamps is not required;
  - after the 2 h duration test the temperature is increased, in order to verify the conditions of 8.2.1.5, up to

    -25 °C ± 1 K and then to -5 °C ± 1 K for operating classes T2 and Tx, each temperature being maintained during 1 h,

    -5 °C ± 1 K for operating classes T1 and T3.

The electronic ballast shall be kept at each relevant temperature and after 1h the lighting test shall be carried out at the corresponding minimum voltage required in 8.2.1.5. The lamps shall start.

- final checking and measurements:
  - dielectric test according to 9.3.1.8;
  - lighting according to 9.3.1.4;
  - visual examination according to 9.3.1.1.

The electronic ballast and the lamps shall not fail during the test and no deterioration shall appear after the test.

9.3.5.4 *Vibration test*

The test shall be carried out with the method and requirements given in EN 61373.

9.3.5.5 *Shock test*

The test shall be carried out with the method and requirements given in EN 61373.

9.3.5.6 *Fire behaviour*

The test shall be carried out with the methods and requirements given in EN 45545-5 which takes precedence over those of Clause 16 of EN 60924.

Annex A
(informative)

Types of lamps

The types of lamps given in Table A.1 and Table A.3 are preferred as being the most commonly used. When appropriate, these types are considered as reference for design and used for electronic ballasts testing.

The same electronic ballasts may also supply other types of lamps given in Table A.2 as indicated on manufacturer's informative documents.

Table A.1 - Types of tubular lamps for electronic ballasts design

Standardised designations with reference to IEC 61231	References of EN 60081 data sheet
FD - 6 - E - G5 - 15/224	1031
FD - 8 - E - G5 - 15/300	1041
FD - 13 - E - G5 - 15/525	1051
FD - 18 - E - G13 - 25/600	1105
FD - 36 - E - G13 - 25/1200	1305

Table A.2: Other types of tubular lamps

Standardised designations with reference to IEC 61231	References of EN 60081 data sheet
FD - 20 - E - G13 - 38/600	1110
FD - 40 - E - G13 - 38/1200	1310
FD - 20 - E - G13 - 38/600	4110
FD - 40 - E - G13 - 38/1200	4310
FD - 20 - E - G13 - 38/600	5110
FD - 40 - E - G13 - 38/1200	5310

Table A.3 - Types of single capped lamps for electronic ballasts design

Standardised designations with reference to IEC 61231	References of EN 60901 data sheet
FSD - 11 - E - 2G7	2011
FSD - 18 - E - 2G11	2218
FSD - 24 - E - 2G11	2224
FSD - 36 - E - 2G11	2236
FSQ - 10 - E - G24q - 1	2510
FSQ - 13 - E - G24q - 1	2513
FSQ - 18 - E - G24q - 2	2518

Annex B
(informative)

Electronic ballast for lamps up to 40 W

This annex gives the overall dimensions of a housing for electronic ballasts having a maximum output power of 40 W capable to supply either one lamp of 40 W maximum or two lamps of 20 W maximum.

The use of this housing for a new electronic ballast design is recommended to offer a possible replacement of an old type for maintenance.

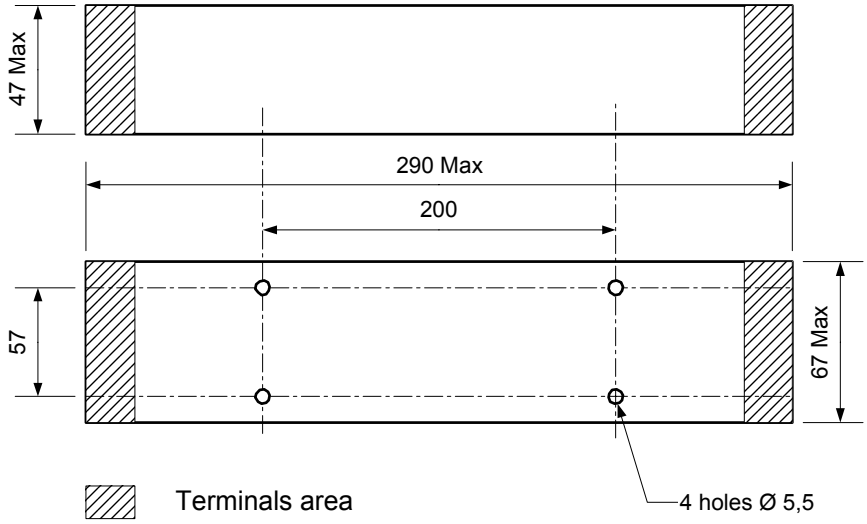


Figure B.1 - Overall dimensions for electronic ballast

The possible schematic diagrams to be used are given in Figure G.1, Figure G.2 and Figure G.3.

Annex C
(informative)

Electronic ballast for lamps up to 40 W

This annex gives the overall dimensions of a housing for electronic ballasts having a maximum output power of 40 W capable to supply either one lamp of 40 W maximum or two lamps of 20 W maximum.

The use of this housing for a new electronic ballast design is recommended to offer a possible replacement of an old type for maintenance.

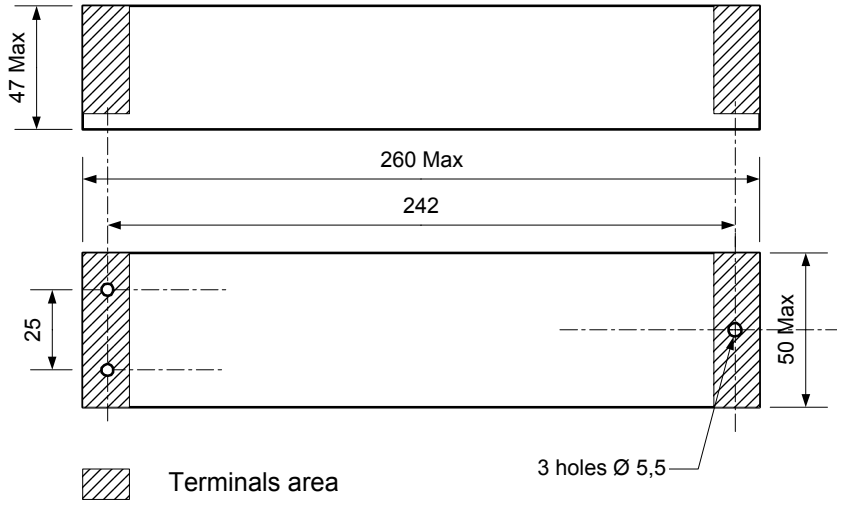


Figure C.1 - Overall dimensions for electronic ballast

The possible schematic diagrams to be used are given in Figure G.1, Figure G.2 and Figure G.3.

Annex D
(informative)

Electronic ballast for lamps up to 15 W

This annex gives the overall dimensions of a housing for electronic ballasts having a maximum output power of 15 W capable to supply one lamp of 15 W.

The use of this housing for a new electronic ballast design is recommended to offer a possible replacement of an old type for maintenance.

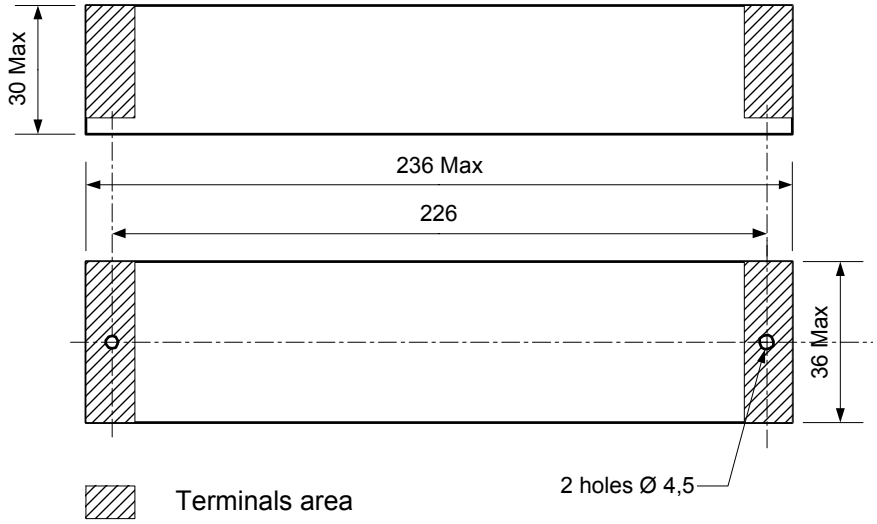


Figure D.1 - Overall dimensions for electronic ballast

The possible schematic diagrams to be used are given in Figure G.4 and Figure G.5.

Annex E
(informative)

Electronic ballast for lamps up to 10 W

This annex gives the overall dimensions of a housing for electronic ballasts having a maximum output power of 20 W capable to supply either one lamp of 10 W maximum or two lamps of 10 W maximum.

The use of this housing for a new electronic ballast design is recommended to offer a possible replacement of an old type for maintenance.

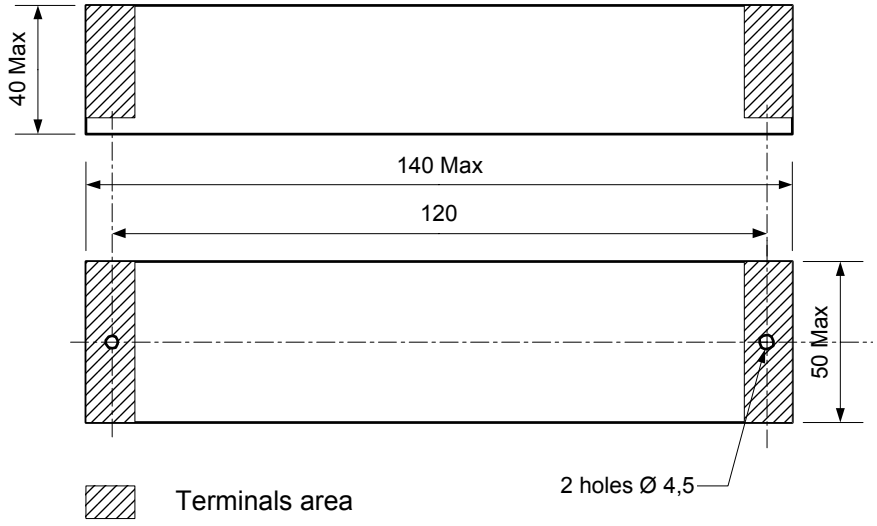


Figure E.1 - Overall dimensions for electronic ballast

The possible schematic diagrams to be used are given in Figure G.4, Figure G.6 and Figure G.7.

Annex F
(informative)

Electronic ballast for lamps up to 10 W

This annex gives the overall dimensions of a housing for electronic ballasts having a maximum output power of 20 W capable to supply one lamp of 10 W maximum.

The use of this housing for a new electronic ballast design is recommended to offer a possible replacement of an old type for maintenance.

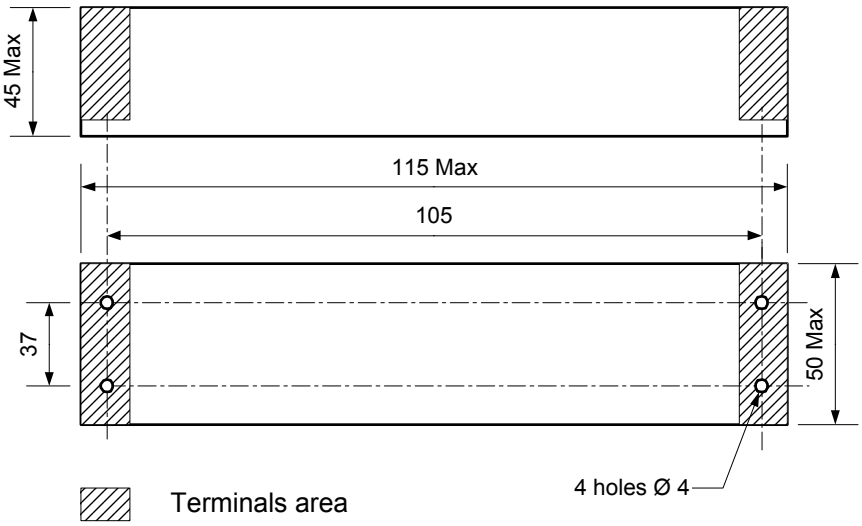


Figure F.1 - Overall dimensions for electronic ballast

The possible schematic diagram to be used is given by in Figure G.4.

Annex G
(informative)

Basic schematic diagrams

This annex gives the basic schematic diagrams for electronic ballasts which are commonly used with the relevant housings given in Annexes B to F.

The diagrams correspond to the housing as follows:

Circuit diagram G.1 is used with housing of Annex B and Annex C;

Circuit diagram G.2 is used with housing of Annex B and Annex C;

Circuit diagram G.3 is used with housing of Annex B and Annex C;

Circuit diagram G.4 is used with housing of Annex D, Annex E and Annex F;

Circuit diagram G.5 is used with housing of Annex D;

Circuit diagram G.6 is used with housing of Annex E;

Circuit diagram G.7 is used with housing of Annex E.

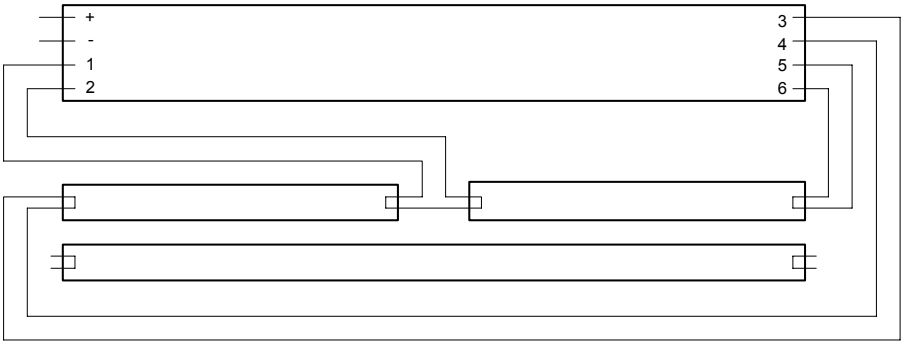


Figure G.1 - One or two tubular lamps

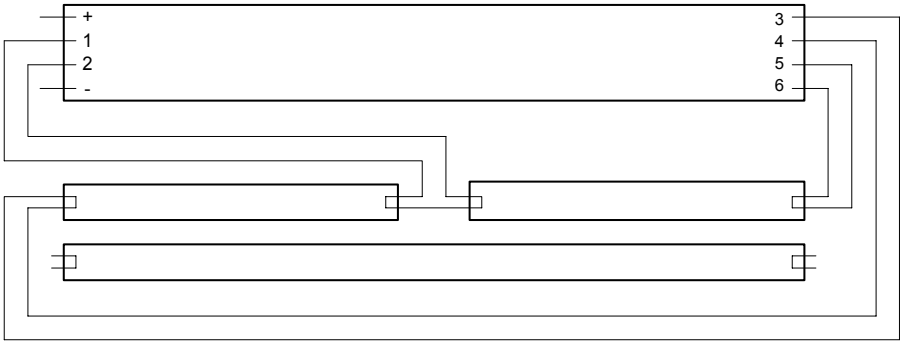


Figure G.2 - One or two tubular lamps

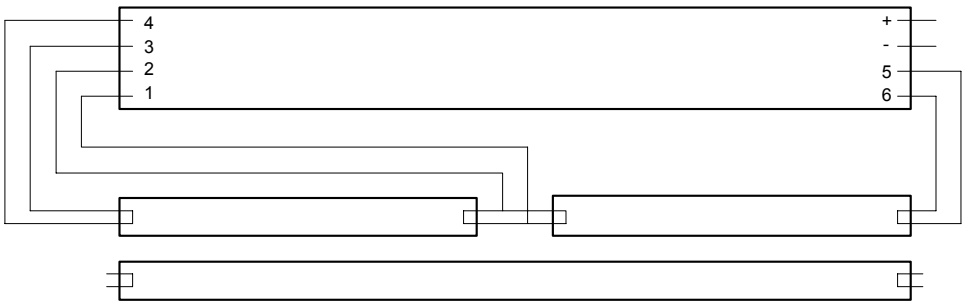


Figure G.3 - One or two tubular lamps

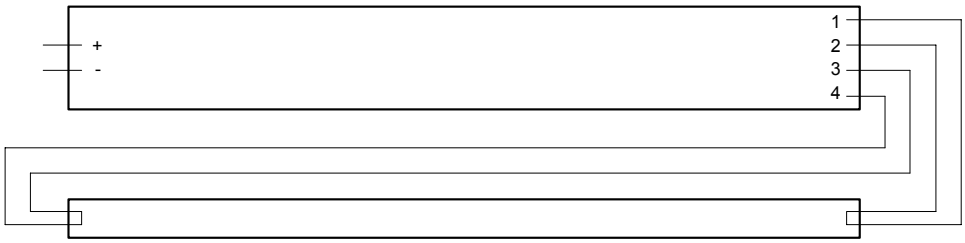


Figure G.4 - One tubular lamp

Figure G.5 - One tubular lamp

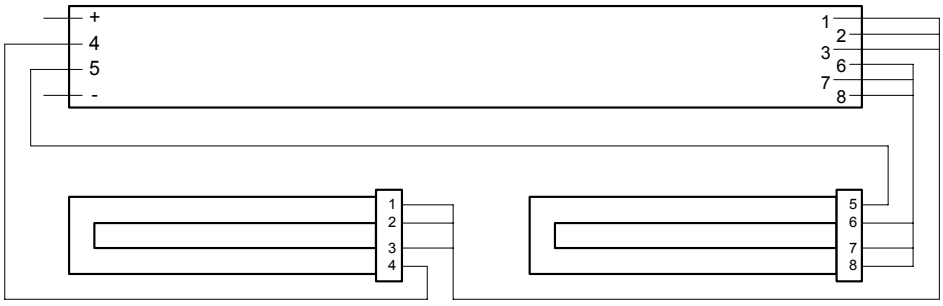


Figure G.6 - One or two single capped lamps

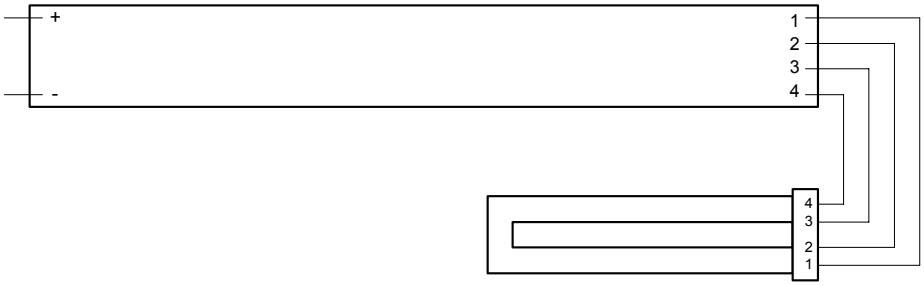


Figure G.7 - One single capped lamp

Annex H
(informative)

Correspondence with EN 60924 requirements

The standard EN 60924, D.C. supplied electronic ballasts for tubular fluorescent lamps - General and safety requirements, deals with electronic ballasts for public transport lighting in its Section 4.

It contains general requirements which are not totally linked with the standards recently established for railway applications.

It seemed useful to introduce the EN 60924 requirements into this railway application standard after up-dating and harmonisation with the existing railway standards.

This annex gives the correspondence between requirements of the two standards giving when useful some comments on the differences. This is given clause by clause by the following.

Table H.1 - Correspondence with EN 60924

Clauses of EN 60924	Correspondence in EN 50311
1 Scope	Covered by Clause 1.
2 Definitions	In Clause 3 definitions of IEC 60050 and CENELEC railway standards take precedence over vocabulary given by EN 60924.
3 General requirements	Given in 8.3.
4 General notes on tests Note of Clause 4d	Covered by 9.1. See Figure 1 of 9.3.2.1.
5 Categories	Not relevant.
6 Marking	Covered and completed by 6.1 and 6.2.
7 Scope	Covered by Clause 1.
8 Terminals	Reference to this clause is made in 8.1.2.
9 Provision for earthing	Covered and completed by 6.1.2 and 8.2.4.5.
10 Creepage distances and clearance	8.1.4 requires the maximum values between EN 60924 and EN 50124-1.
11 Protection against accidental contact with live part	Reference to this clause is made in 8.3.
12 Moisture resistance	9.3.5.1 refers to standardised test method given by EN 60068-2-30

Table H.1 - Correspondence with EN 60924 (continued)

Clauses of EN 60924	Correspondence in EN 50311
13 Electric strength	Covered and completed by 9.3.1.8
14 Fault conditions	Not applicable due to required individual internal short-circuit protection. See 8.1.5.
15 Screws, current-carrying parts and connections	Reference to this clause is made in 8.1.2.
16 Resistance to heat and fire	Covered by 8.3 and 9.3.5.6 railway standard taking precedence.
20 Scope	Covered by Clause 1.
21 Marking	Covered by 6.1.2.
22 Pulse voltages	Covered by 9.3.4.5 taking account of EMC requirements.
23 Abnormal conditions	Covered by 8.2.2.3 and 9.3.4.

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: +44 (0)20 8996 9000. Fax: +44 (0)20 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: +44 (0)20 8996 9001. Fax: +44 (0)20 8996 7001. Email: orders@bsi-global.com. Standards are also available from the BSI website at http://www.bsi-global.com.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: +44 (0)20 8996 7111. Fax: +44 (0)20 8996 7048. Email: info@bsi-global.com.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: +44 (0)20 8996 7002. Fax: +44 (0)20 8996 7001. Email: membership@bsi-global.com.

Information regarding online access to British Standards via British Standards Online can be found at http://www.bsi-global.com/bsonline.

Further information about BSI is available on the BSI website at http://www.bsi-global.com.

Copyright

BSI
389 Chiswick High Road
London
W4 4AL