

Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment

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British Standard

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National foreword

This British Standard has been prepared under the direction of the General Electrotechnical Standards Policy Committee and is the English language version of EN 55015 *Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment*, including corrigendum December 1997 published by the European Committee for Electrotechnical Standardization (CENELEC). It was derived by CENELEC from, and is technically equivalent to, CISPR 15:1992 published by the International Electrotechnical Commission (IEC).

This standard is one of a number of standards related to European Council Directive 89/336/EEC, dated 3 May 1989 (referred to as the Electromagnetic Compatibility (EMC) Directive) as amended on 28 April 1992 by Council Directive 92/31/EEC. This Directive together with its amendment has been implemented by H.M. Government as Statutory Instrument 1992 No. 2372. The amendment provides for a transitional period lasting until 31 December 1995 during which a manufacturer may choose between the following two options when marketing his products in the single market.

- a) To manufacture in accordance with the requirements of the EMC Directive, making a declaration of conformity and affixing the CE Mark: this route provides access to markets of all Member States in the Single Market.
- b) To manufacture in accordance with the national regulations existing on 30 June 1992 in the country or countries in which the product is to be marketed: this route provides access only to those EC markets in which the apparatus is in compliance with the national regulations of those Member States.

As far as products covered by this standard are concerned, the options for compliance in the UK are given in the table overleaf.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, the EN title page, pages 2 to 40, 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.

Options for the compliance in the UK						
Manufacturer's option	EC Directive	UK regulations	Standards to be complied with			
			Emission			Immunity
			Harmonics	Voltage fluctuations	Radio interference	All aspects
a)	89/336/EEC	SI 1992 No. 2327 ^a	BS 5406-2:1988	BS 5406-3:1988	BS EN 55015:1993	BS EN 50082-1
b)	76/890/EEC ^b	SI 1989 No. 561	—	—	BS 5394:1988 ^c	—
^a UK Regulations implementing Directive 89/336/EEC, as amended by 92/31/EEC, came into force on 28 October 1992. ^b As amended by Commission Directive 82/500/EEC and adapted to technical progress by Commission Directive 87/310/EEC. ^c BS 5394:1988, together with Amendment No. 1, implemented EN 55015:1987.						

English version

Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment

(CISPR 15:1992)

Limites et méthodes de mesure des perturbations radioélectriques produites par les appareils électriques d'éclairage et les appareils analogues
(CISPR 15:1992)

Grenzwerte und Meßverfahren für Funkstörungen von elektrischen Beleuchtungseinrichtungen und ähnlichen Elektrogeräten
(CISPR 15:1992)

This European Standard was approved by CENELEC on 1992-12-09. 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

At the request of the CENELEC Technical Committee SC 110A, EMC Products, the International Standard CISPR 15:1992 was submitted to the CENELEC Unique Acceptance Procedure (UAP) in March 1992 for acceptance as a European Standard.

The text of the International Standard was approved by CENELEC as EN 55015 on 9 December 1992.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1993-09-01
- latest date of withdrawal of conflicting national standards (dow) 1998-01-01

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1 Scope

1.1 This standard applies to the emission (radiated and conducted) of radio frequency disturbances from and to the immunity to radio frequency disturbances of:

- all lighting equipment with a primary function of generating and/or distributing light intended for illumination purposes, and intended either for connection to the low voltage electricity supply or for battery operation;
- the lighting part of multi-function equipment where one of the primary functions of this is illumination;
- independent auxiliaries exclusively for use with lighting equipment;
- UV and IR radiation appliances;
- neon advertising signs;
- street/flood lighting intended for outdoor use only;
- transport lighting (installed in buses, trains, etc.).

NOTE Requirements concerning immunity are under consideration.

Excluded from the scope of this standard are:

- apparatus for which the electromagnetic compatibility requirements in the radio frequency range are explicitly formulated in other IEC or CISPR standards.

NOTE Examples are:

- built-in lighting devices in other equipment, for example scale illumination or neon indicators;
- photocopiers;
- slide projectors.

1.2 The frequency range covered is 9 kHz to 400 GHz.

1.3 Multi-function equipment

Multi-function equipment which is subjected simultaneously to different clauses of this standard and/or other standards shall meet the provisions of each clause/standard with the relevant functions in operation.

1.4 The limits in this standard have been determined on a probabilistic basis to keep the suppression of disturbances within economically reasonable limits while still achieving an adequate radio protection and electromagnetic compatibility. In exceptional cases radio frequency disturbance may occur, in spite of compliance with the limits. In such cases additional provisions may be required.

2 Normative references

The following standards are referred to in this publication:

IEC 50(161):1990, *International Electrotechnical Vocabulary (IEV). Chapter 161: Electromagnetic Compatibility*.

IEC 50(845):1987, *International Electrotechnical Vocabulary (IEV). Chapter 845: Lighting*.

CISPR 14:1993, *Limits and methods of measurement of radio disturbance characteristics of electrotechnical motor-operated and thermal appliances for household and similar purposes, electric tools and similar electric apparatus*.

CISPR 16:1987, *CISPR Specification for Radio Interference Measuring Apparatus and Measuring Methods. Amendment No. 1 (1980) and Amendment No. 2 (1983)*.

3 Definitions

For the purpose of this standard, the definitions which apply are contained in the International Electrotechnical Vocabulary (IEV), IEC 50, chapter 161: Electromagnetic compatibility, and chapter 845: Lighting.

Continuous disturbance may be either broadband, for instance caused by switching operations or by unstable gas-discharges in the lamp electrode region, or may be narrowband, for instance caused by electronic control devices operating at dedicated frequencies.

NOTE Instead of the concept of “broadband” and “narrowband” disturbances, in this standard a distinction is made between two related kinds of disturbance, defined by the type of the applied detector. For this purpose limits have been defined with respect to the measurement with the quasi-peak detector and with the average detector. By using this approach also a combination of broadband and narrowband disturbances can be assessed.

4 Limits

4.1 Insertion loss of luminaires with or without starters for fluorescent lamps

Luminaires, connected to electrical supplies feeding residential load in the voltage range 100 V/250 V between phases or phase and earth, shall have a minimum insertion loss as given in Table 1, provided these luminaires are designed for:

- linear fluorescent lamps with a nominal diameter of 15 mm, 25 mm or 38 mm;
- circular fluorescent lamps with a nominal diameter of 28 mm or 32 mm;
- U-type fluorescent lamps with a nominal diameter of 15 mm, 25 mm or 38 mm;
- single-capped fluorescent lamps, without integrated starter and with a nominal diameter of 15 mm;
- single-capped fluorescent lamps, linear shaped, twin and quad tube, with integral starter and having a nominal tube diameter or 12 mm.

Table 1 — Minimum values of insertion loss for the frequency range 150 kHz to 1 605 kHz

Frequency range (kHz)	Minimum insertion loss (dB)
150 to 160	28
160 to 1 400	28 to 20 ^a
1 400 to 1 605	20
^a Decreasing linearly with the logarithm of frequency.	

The requirements do not apply to luminaires in which the lamps are powered at a frequency in excess of 100 Hz.

4.2 Disturbance voltages of lighting devices

All types of lighting equipment for which the insertion loss limits of 4.1 do not apply shall comply with the mains terminal voltage limits as shown in Table 2.

Table 2 — Limits of mains terminal disturbance voltage in the range 9 kHz to 30 MHz

Frequency range	Limits in dB (μV) ^a	
	Quasi-peak	Average ^d
9 kHz to 50 kHz ^c	110	—
50 kHz to 150 kHz ^c	90 to 80 ^b	—
150 kHz to 0,5 MHz	66 to 56 ^b	56 to 46 ^b
0,5 MHz to 5 MHz	56	46
5 MHz to 30 MHz	60	50
NOTES ^a At the transition frequency the lower limit applies. ^b The limit decreases linearly with the logarithm of the frequency in the ranges 50 kHz to 150 kHz and 150 kHz to 0,5 MHz. ^c The limit values in the frequency range 9 kHz to 150 kHz are considered to be "provisional limits" which may be modified after some years of experience. In Japan the limit values in the frequency range 9 kHz to 150 kHz are not applicable. ^d If it is certain that only broadband disturbance sources are present, then the average measurements need not be made.		

4.3 Disturbance voltages for self-ballasted fluorescent lamps

For self-ballasted fluorescent lamps the limits shown in Table 2 apply.

4.4 Radiated electromagnetic disturbances

For lighting equipment with lamp operating frequencies in excess of 100 Hz and luminaire dimensions smaller than 1,6 m, the limits of Table 3 column 2 apply.

When the lighting equipment to be measured exceeds the length of 1,6 m, but is smaller than 2,6 m the limits of Table 3 column 3 apply. When the luminaire exceeds 2,6 m in length but is smaller than 3,6 m the limits of Table 3 column 4 apply.

Table 3 — Limits of the magnetic field induced current in a 2 m, 3 m or a 4 m loop antenna around the device under test, measured with the quasi-peak detector

Frequency range	Limits in dB (μA) for loop diameter		
	2 m	3 m	4 m
9 kHz to 70 kHz ^c	88	81	75
70 kHz to 150 kHz ^c	88 to 58 ^a	81 to 51 ^a	75 to 45 ^a
150 kHz to 2,2 MHz	58 to 26 ^a	51 to 22 ^a	45 to 16 ^a
2,2 MHz to 3,0 MHz	58	51	45
3,0 MHz to 30 MHz	22	15 to 16 ^b	9 to 12 ^b

^a Decreasing linearly with the logarithm of the frequency.
^b Increasing linearly with the logarithm of the frequency.
^c In Japan the limits for frequencies 9 kHz to 150 kHz are not applicable.

Frequency bands designated to ISM purpose shall be taken into account (see 4.5).

For lighting equipment with operating frequencies of 100 Hz or below no tests or limits for radiated fields apply.

4.5 Limits at designated frequencies

Certain frequencies are designated by the International Telecommunication Union (ITU) for use as fundamental frequencies for ISM equipment (Resolution No. 63 (1979) of the ITU regulations). These frequencies and related requirements are listed in Table 4.

Lighting equipment is permitted to operate at these frequencies. The related requirements and further ITU provisions shall then apply, in addition to the limits as given in Table 4.

NOTE In individual countries different or additional frequencies may be designated for use by ISM equipment.

Table 4 — Limits of disturbance field strengths at frequencies designated for use by ISM equipment

Centre frequency (MHz)	Frequency band (MHz)	Limit of disturbance field strength dB (μV/m) measured at 10 m distance	No. of appropriate footnote to the table of frequency allocations of the ITU radio regulations
6,780	6,765 to 6,795	100 (magnetic component)	524 ^a
13,560	13,553 to 13,567	100 (magnetic component)	534
27,120	26,957 to 27,283	100 (magnetic component)	546
40,680	40,66 to 40,70	100 (electric component)	548
433,922	433,05 to 434,79	100 (electric component)	661 ^a , 662 (Region 1 only)
915,000	902 to 928	100 (electric component)	707 (Region 2 only)
2 450	2 400 to 2 500	100 (electric component)	752
5 800	5 725 to 5 875	100 (electric component)	806
24 125	24 000 to 24 250	100 (electric component)	881
61 250	61 000 to 61 500	100 (electric component)	911 ^a
122 500	122 000 to 123 000	100 (electric component)	916 ^a
245 000	244 000 to 246 000	100 (electric component)	922 ^a

^a Use of these frequency bands shall be subjected to special authorization by administrations concerned in agreement with other administrations whose radio communication services might be affected.

4.6 Incandescent lamps and their luminaires

Incandescent lamps and their luminaires, where the lamps are mains frequency or battery operated, are not expected to produce electromagnetic disturbance nor are they susceptible to such disturbances. Therefore they are deemed to fulfil all relevant requirements of this standard without further testing.

4.7 Other lighting devices and auxiliaries

Limits are under consideration for:

- independent auxiliaries exclusively for use with lighting equipment;
- UV and IR radiation appliances¹⁾;
- street/flood lighting intended for outdoor use only;
- neon signs;
- transport lighting (installed in buses, trains, etc.);
- dimmers for lighting equipment¹⁾.

(Regulating controls incorporating semiconductor devices intended for other applications: see CISPR 14, 7.2.5.)

5 Method of measurement of the insertion loss of luminaires

5.1 Circuits for the measurement of the insertion loss

5.1.1 For luminaires as described in 4.1, the insertion loss is measured as shown in Figure 1 for linear and U-type luminaires and in Figure 2 for circular lamp luminaires.

Dummy lamps are specified in 5.2.4.

5.1.2 In the case of luminaires for fluorescent lamps having a nominal diameter of 25 mm, but which are interchangeable with lamps having a nominal diameter of 38 mm, the measurement of insertion loss shall be made with a dummy lamp with a nominal diameter of 38 mm, unless the manufacturer's instructions prescribe the exclusive use of a 25 mm diameter lamp.

5.1.3 For luminaires for single-capped fluorescent lamps with integral starter, the insertion loss is measured as shown in Figure 3, with dummy lamps as specified in 5.2.4.

5.2 Measuring set

The measuring set consists of the following parts:

5.2.1 Radio-frequency generator

This is a sine-wave generator, having an output impedance of 50 Ω and being suitable for the frequency range covered by this measurement.

5.2.2 Balance-to-unbalance transformer

The low-capacitance balance-to-unbalance transformer is used to obtain a symmetrical voltage from the radio-frequency generator. Electrical and constructional requirements are given in Annex A.

5.2.3 Measuring receiver and network

Either the 150 Ω V-network in conjunction with the CISPR receiver, according to CISPR 16, or the measuring network shown in Figure 4, in conjunction with an r.f. millivoltmeter with high input impedance, shall be used.

In the measuring network shown in Figure 4, the resistors, capacitor and the switch shall have such high frequency properties that the construction according to the circuit has a frequency characteristic that is flat within 0,5 dB in the frequency range 150 kHz to 1 605 kHz.

5.2.4 Dummy lamps

The dummy lamps, which are used in the circuits of Figure 1, Figure 2, and Figure 3, simulate the r.f. properties of the fluorescent lamps and are shown in Figure 5a, Figure 5b, Figure 5c, Figure 5d, Figure 5e and Figure 5f.

¹⁾ Until specific requirements are formulated in this standard, CISPR 14 remains applicable.

When mounting the dummy lamp in the luminaire it shall remain parallel to the metalwork of the luminaire. Any support necessary to achieve this shall not alter the capacitance between the dummy lamp and luminaire.

The length of the dummy lamp shall be equal to the length of the fluorescent lamp for which the luminaire is designed. The length of the metal tube shall be as indicated on the relevant dummy lamp data sheet of this standard.

5.2.5 Measuring arrangements

- a) The length of the unscreened connection leads between the transformer and the input terminals of the dummy lamp shall be as short as possible, not exceeding 0,1 m in length.
- b) The length of the coaxial connection leads between luminaire and measuring network shall not exceed 0,5 m.
- c) In order to avoid parasitic currents, there shall be only one earth connection at the measuring network. All earth terminals are to be connected to this point.

5.3 Luminaire

With the exception of the possible modification as set out in 5.3.3 and replacement of the lamps, the luminaire is measured as manufactured.

5.3.1 When the luminaire incorporates more than one lamp, each lamp is replaced in turn by the dummy lamp. The insertion loss of multi-lamp luminaires in which the lamps are powered in parallel shall be measured for each lamp and the minimum value of insertion loss measured shall be used for comparison with the relevant limit.

5.3.2 When measuring series-operated lamp luminaires, both lamps shall be replaced by dummy lamps. The input terminals of one dummy lamp shall be connected to the balance-to-unbalance transformer and the input terminals of the remaining dummy lamp are terminated with 150 Ω (high frequency type).

5.3.3 When interchangeable starters having integral capacitors are used, as is the usual case, the starter is to be removed and replaced by a capacitor of 5 000 pF $\pm$ 10 %.

Care shall be taken that the test capacitor maintains its characteristics over the whole frequency range covered by the measurement.

However, in cases where the manufacturer fits a capacitor external to the starter and gives a warning against the use of an additional starter capacitor, the original capacitor is retained and no test capacitor is added.

5.3.4 If the luminaire has a frame of insulating material, the back of the luminaire shall be placed on a metal sheet, to be connected to the reference earth of the measuring network.

5.4 Measurement procedure

5.4.1 The insertion loss is obtained by comparing the voltage U_1 obtained by connecting the output terminals of the transformer to the terminals of the measuring network, with the voltage U_2 obtained when the transformer is connected to the measuring network through the luminaire to be measured.

5.4.2 Voltage U_1

The output voltage U_1 (between 2 mV and 1 V) of the transformer is measured by means of the measuring receiver. For this purpose a direct connection is made between the transformer and the input terminals of the measuring network. The voltage U_1 is measured between either of the two input terminals of the measuring network and earth (across the 150 Ω resistor) and shall have substantially the same value, that is to say independent of the arrangement of the measuring network. See Annex A for checking of the balance-to-unbalance transformer properties and the saturation effects.

5.4.3 Voltage U_2

The voltage U_2 measured with the luminaire connected between the transformer and measuring network may have different values and therefore may depend on the two positions of the switch of the measuring network; the higher voltage reading is recorded as U_2 .

5.4.4 The insertion loss is given by $20 \lg \frac{U_1}{U_2}$ dB

NOTE The value of the insertion loss as obtained by this method of measurement gives good correlation between the dummy lamp and real lamps when used in the same luminaire.