

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

The European Standard EN 55015:2000, with the incorporation of amendment A1:2001, has the status of a British Standard

ICS 29.140.01; 33.100.10

## National foreword

This British Standard is the official English language version of EN 55015:2000, including amendment A1:2001. It is identical with CISPR 15:2000. It supersedes BS EN 55015:1996 which will be withdrawn on 2003-08-01

The start and finish of text introduced or altered by CENELEC amendment A1 is indicated in the text by tags **A1** **A1**.

The UK participation in its preparation was entrusted by Technical Committee GEL/210, EMC policy, to Subcommittee GEL/210/11, EMC products, which has the responsibility to:

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

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

(includes amendment A1:2001)

(CISPR 15:2000)

Limites et méthodes de mesure des  
perturbations radioélectriques produites  
par les appareils électriques d'éclairage et  
les appareils analogues  
(inclut l'amendement A1:2001)  
(CISPR 15:2000)

Grenzwerte und Messverfahren für die  
Funkstöreigenschaften von elektrischen  
Beleuchtungsrichtungen und ähnlichen  
Elektorgeräten  
(enthält Änderung A1:2001)  
(CISPR 15:2000)

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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

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

### Foreword

The text of document CISPR/F/303/FDIS, future edition 6 of CISPR 15, prepared by CISPR SC F, Interference relating to household appliances, tools lighting equipment and similar apparatus, was submitted to the IEC-CENELEC as EN 55015 on 2000-08-01.

This European Standard supersedes EN 55015:1996 and its amendments A1:1997 and A2:1999.

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) 2001-05-01
- latest date by which the national standards conflicting with EN have to be withdrawn (dow) 2003-08-01

Annexes designated “normative” are part of the body of the standard. In this standard, annexes A and ZA are normative. Annex ZA has been added by CENELEC.

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### Endorsement notice

The text of the International Standard CISPR 15:2000 was approved by CENELEC as a European Standard without any modification.

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### Foreword to amendment A1

The text of document CISPR/F/337/FDIS, future amendment 1 to CISPR 15:2000, prepared by CISPR SC F, Interference relating to household appliances, tools lighting equipment and similar apparatus, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 to EN 55015:2000 on 2001-12-01.

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Annexes designated “normative” are part of the body of the standard. In this amendment, Annex ZA is normative. Annex ZA has been added by CENELEC.

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### Endorsement notice

The text of amendment 1:2001 to the International Standard CISPR 15:2000 was approved by CENELEC as an amendment to the European Standard without any modification.

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## LIMITS AND METHODS OF MEASUREMENT OF RADIO DISTURBANCE CHARACTERISTICS OF ELECTRICAL LIGHTING AND SIMILAR EQUIPMENT

### 1 Scope

This standard applies to the emission (radiated and conducted) of radiofrequency disturbances from:

- 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 equipment;
- neon advertising signs;
- street/flood lighting intended for outdoor use;
- transport lighting (installed in buses and trains).

Excluded from the scope of this standard are:

- lighting equipment operating in the ISM frequency bands (as defined in Resolution 63 (1979) of the ITU Radio Regulation);
- lighting equipment for aircraft and airports;
- apparatus for which the electromagnetic compatibility requirements in the radio-frequency range are explicitly formulated in other IEC or CISPR standards.

NOTE NOTE Examples are:

NOTE – built-in lighting devices in other equipment, for example scale illumination or neon devices;

NOTE – photocopiers;

NOTE – slide projectors;

NOTE – lighting equipment for road vehicles.

The frequency range covered is 9 kHz to 400 GHz.

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.

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 level of radio protection and electromagnetic compatibility. In exceptional cases, additional provisions may be required.

## 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(161):1990, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility*

IEC 60155:1993, *Glow-starters for fluorescent lamps*

IEC 60598: *Luminaires*

CISPR 11:1997, *Industrial, scientific and medical (ISM) radio-frequency equipment – Electromagnetic disturbance characteristics – Limits and methods of measurement*

CISPR 16-1:1999, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1: Radio disturbance and immunity measuring apparatus*

## 3 Definitions

For the purpose of this International Standard, the definitions contained in IEC 60050(161) apply.

Continuous disturbance may be either broadband, for instance caused by the 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 NOTE Instead of the concept of "broadband" and "narrowband", a distinction is made in this standard 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, a combination of broadband and narrowband disturbances can also be assessed.

## 4 Limits

### 4.1 Frequency ranges

In 4.2, 4.3 and 4.4, limits are given as a function of frequency range. No measurements need to be performed at frequencies where no limits are specified.

NOTE NOTE The World Administrative Radiocommunications Conference (WARC) has in 1979 reduced the lower frequency limit in region 1 to 148,5 kHz; for applications falling within the scope of this standard, tests at 150 kHz are considered adequate, since 148,5 kHz falls within the receiver bandwidth.

#### 4.2 Insertion loss

The minimum values of the insertion loss for the frequency range 150 kHz to 1 605 kHz are given in table 1.

**Table 1 – Minimum values of insertion loss**

Frequency range kHz	Minimum values dB
150 to 160	28
160 to 1 400	28 to 20*
1 400 to 1 605	20
* Decreasing linearly with the logarithm of frequency.	

#### 4.3 Disturbance voltages

##### 4.3.1 Mains terminals

The limits of the mains terminal disturbance voltages for the frequency range 9 kHz to 30 MHz are given in table 2a.

**Table 2a – Disturbance voltage limits at mains terminals**

Frequency range	Limits dB(μV)*	
	Quasi-peak	Average
9 kHz to 50 kHz**	110	–
50 kHz to 150 kHz**	90 to 80***	–
150 kHz to 0,5 MHz	66 to 56***	56 to 46***
0,5 MHz to 2,51 MHz	56	46
2,51 MHz to 3,0 MHz	73	63
3,0 MHz to 5,0 MHz	56	46
5 MHz to 30 MHz	60	50
* At the transition frequency, the lower limit applies.		
** 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.		
*** 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.		
NOTE In Japan, the limits in the frequency range 9 kHz to 150 kHz are not applicable. Moreover, the limits 56 dB(μV) quasi-peak and 46 dB(μV) average apply between 2,51 MHz and 3 MHz.		

##### 4.3.2 Load and control terminals

The limits of the load and control terminal disturbance voltages for the frequency range 150 kHz to 30 MHz are given in table 2b.

**Table 2b – Disturbance voltage limits at load and control terminals**

Frequency range MHz	Limits dB( $\mu$ V)*	
	Quasi-peak	Average
0,15 to 0,50	80	70
0,50 to 30	74	64

\* At the transition frequency, the lower limit applies.

#### 4.4 Radiated electromagnetic disturbances

The quasi-peak limits of the magnetic component of the radiated disturbance field strength in the frequency range 9 kHz to 30 MHz, measured as a current in 2 m, 3 m or 4 m loop antennas around the lighting equipment, are given in table 3.

The limits for the 2 m loop diameter apply to equipment not exceeding a length of 1,6 m, those for the 3 m loop diameter for equipment having a length in between 1,6 m and 2,6 m and those for the 4 m loop diameter for equipment having a length in between 2,6 m and 3,6 m.

**Table 3 – Radiated electromagnetic disturbance limits**

Frequency range MHz	Limits for loop diameter dB( $\mu$ A)*		
	2 m	3 m	4 m
9 kHz to 70 kHz	88	81	75
70 kHz to 150 kHz	88 to 58**	81 to 51**	75 to 45**
150 kHz to 2,2 MHz	58 to 26**	51 to 22**	45 to 16**
2,2 MHz to 3,0 MHz	58	51	45
3,0 MHz to 30 MHz	22	15 to 16***	9 to 12***

NOTE \* At the transition frequency, the lower limit applies.  
 NOTE \*\* Decreasing linearly with the logarithm of the frequency.  
 NOTE \*\*\* Increasing linearly with the logarithm of the frequency.  
 NOTE NOTE In Japan, the limits for frequencies 9 kHz to 150 kHz do not apply.

## 5 Application of the limits

### 5.1 General

Applications of the limits for the various kinds of lighting equipment as mentioned in the scope of this standard are given in 5.2 to 5.10.

No emission requirements apply to lamps other than self-ballasted lamps nor to auxiliaries incorporated in luminaires, in self-ballasted lamps or in semi-luminaires. (See, however, note 2 of 5.3.1 in this respect.)

The disturbance caused by manual or automatic operation of a switch (external or included in equipment) to connect or disconnect the mains shall be disregarded. This includes manual on/off switches or, for example, switches activated by sensors or ripple control receivers. However, switches which will be repeatedly operated (e.g. such as those of advertising signs) are not included in this exception.

## **5.2 Indoor luminaires**

### **5.2.1 General**

The following conditions apply to all kinds of indoor luminaires irrespective of the environment in which they are used.

### **5.2.2 Incandescent lamp luminaires**

Incandescent lamp luminaires where the lamps are a.c. mains or d.c. operated, or which do not incorporate a light regulating device or electronic switch, are not expected to produce electromagnetic disturbances. Therefore, they are deemed to fulfil all relevant requirements of this standard without further testing.

NOTE NOTE Where, in this standard, the term "incandescent lamp" is used, all types of incandescent lamps including halogen lamps are meant.

### **5.2.3 Fluorescent lamp luminaires**

The minimum values of insertion loss of table 1 shall apply where a fluorescent lamp luminaire is a starter switch operated type and designed for one of the following lamp types:

- 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 integrated starter and having a nominal tube diameter of 12 mm.

### **5.2.4 Other luminaires**

Indoor luminaires other than described in 5.2.2 or 5.2.3 shall comply with the mains terminal voltage limits given in table 2a.

Where the luminaire supplies the lamp(s) with a current having an operation frequency in excess of 100 Hz, it shall comply with the radiated disturbance limits given in table 3.

Where the light output of the luminaire is regulated by an external device, the disturbance voltage at the control terminals shall not exceed the limits given in table 2b.

### **5.3 Independent auxiliaries exclusively for use with lighting equipment**

#### **5.3.1 General**

Independent auxiliaries are electric or electronic devices designed to be applied external to a luminaire and to be used to control the current or voltage of a discharge or incandescent lamp. Examples are dimmers, transformers and convertors for lamps, ballasts for discharge lamps (including fluorescent lamps) and semi-luminaires for compact fluorescent lamps and for incandescent lamps.

NOTE NOTE 1 The requirements described in this subclause (5.3) are for the sole purpose of checking the electromagnetic emission characteristics of the auxiliary itself. Due to the variety of wiring circuits, it is impossible to describe requirements for the installation. In this respect, it is recommended that the manufacturer give guidelines for the proper use of the auxiliary.

NOTE NOTE 2 The requirements of this subclause (5.3) may be used for testing auxiliaries intended to be built into a luminaire. However, there is no obligation for such testing. Moreover, even when the auxiliary complies with the requirements of this subclause, the luminaire will always be tested.

#### **5.3.2 Independent light regulating devices**

##### **5.3.2.1 Types of devices**

There are two types of light regulating devices: those like dimmers which directly regulate the lamps, and those which have a remote control function to regulate the light output via a ballast or convertor.

##### **5.3.2.2 Independent directly operating light regulating devices**

Where such devices incorporate semiconductors, they shall comply with the terminal voltage limits given in tables 2a and 2b, otherwise no limits apply.

When several light regulating devices are contained in one product or enclosure, and when each individual device consists of an entirely self-contained regulating circuit (including all suppression components) and operates independently of the others (i.e. does not control, either by design or fortuitously, any load controlled by another individual regulator), then each device is tested separately.

##### **5.3.2.3 Independent remote control devices**

Where such devices generate a d.c. or low-frequency (<500 Hz) control signal, no limits apply. For radiofrequency or infrared operating devices, this standard does not apply. Other independent remote control devices shall comply with the terminal voltage limits given in tables 2a and 2b.

#### **5.3.3 Independent transformers and convertors for incandescent lamps**

##### **5.3.3.1 General**

Transformers for incandescent lamps change only the voltage and do not convert the mains frequency, whereas convertors also convert the frequency. Both kinds of devices can incorporate means for regulating the light output of the lamps.

### 5.3.3.2 Independent transformers

For voltage transformers for incandescent lamps which do not regulate the voltage by means of active electronic components, the condition of 5.2.2 applies. Other independent transformers for incandescent lamps shall comply with the terminal voltage limits given in tables 2a and 2b.

### 5.3.3.3 Independent convertors

Independent electronic convertors for incandescent lamps shall either:

- a) comply with the terminal voltage limits given in tables 2a and 2b; or,
- b) where the convertor has a non-detachable load supply cable, or where the manufacturer gives strict installation instructions which define the position, type and maximum length of cable(s) to be connected to the lamp(s), then the convertor shall comply with the terminal voltage limits given in table 2a and with the radiated disturbance limits given in table 3, under these conditions.

### 5.3.4 Independent ballasts for fluorescent and other discharge lamps

**5.3.4.1** Independent ballasts designed for a type of fluorescent lamp as mentioned in 5.2.3 and operated with starter shall comply with the minimum values of insertion loss given in table 1.

**5.3.4.2** Other independent ballasts shall comply with the mains terminal voltage limits given in table 2a.

Where the ballast supplies the lamp with a current having a frequency in excess of 100 Hz, it shall comply with the radiated disturbance limits given in table 3.

Where the light is regulated by an external device, the voltage limit at the control terminals of the ballast shall not exceed the limits given in table 2b.

### 5.3.5 Semi-luminaires

Semi-luminaires for compact fluorescent lamps and for incandescent lamps, sometimes called adaptors, are devices equipped, on the one side, with an Edison screw or bayonet cap to allow mounting in a standard incandescent lampholder and, on the other side, with a lampholder to allow the insertion of a replaceable light source.

Semi-luminaires shall comply with the terminal voltage limits given in table 2a.

Where the light source is operated at a frequency exceeding 100 Hz, the unit shall comply with the radiated disturbance limits given in table 3.

### 5.3.6 Independent starters and igniters

Independent starters and igniters for fluorescent and other discharge lamps are tested in a circuit as described in 8.9. They shall comply with the terminal voltage limits given in table 2a.

#### **5.4 Self-ballasted lamps**

For self-ballasted lamps, the ballasting and starting arrangements are encapsulated with the lamp into one single unit. These lamps are fitted with Edison screw or bayonet caps and can be inserted directly into an appropriate holder.

Self-ballasted lamps shall comply with the terminal voltage limits given in table 2a.

Where the light source is operated at a frequency exceeding 100 Hz, the unit shall comply with the radiated disturbance limits given in table 3.

#### **5.5 Outdoor lighting appliances**

##### **5.5.1 General**

For the purpose of this standard, the term "outdoor lighting" is used for the general lighting of public areas such as streets, walkways, cycle paths, motorways, tunnels, car parks, service stations and outdoor sports and recreational areas, for security and floodlighting of buildings and the like. Moreover, requirements described in this subclause (5.5) apply to the (outdoor) lighting appliances on private grounds, industrial estates and the like.

However, such lighting equipment may be subject to specific emission requirements which are not covered by this standard, for example airport lighting.

This subclause (5.5) does not apply to neon and other advertising signs.

##### **5.5.2 Mounting system**

Generally, an outdoor lighting appliance is built up of a support and one or more luminaires. The support could be:

- a pipe (bracket) or the like;
- a mast (column) arm;
- a post top;
- a span or suspension wires;
- a wall or ceiling.

Unless otherwise stated, the emission requirements described in this subclause (5.5) apply to the luminaire (including the lamp) and no requirements apply to the luminaire support.

##### **5.5.3 Integrated switching devices**

Disturbances caused by the operation of integrated switching devices such as ripple control receivers shall be disregarded.

##### **5.5.4 Incandescent lamp luminaires**

The condition of 5.2.2 applies.



### 5.5.5 Fluorescent lamp luminaires

Luminaires using a type of fluorescent lamp as mentioned in 5.2.3 and operating with a starter shall comply with the minimum values of insertion loss given in table 1.

### 5.5.6 Other luminaires

Outdoor luminaires other than described in 5.5.4 or 5.5.5 shall comply with the mains terminal voltage limits given in table 2a.

Where the lamp(s) in the luminaire is (are) supplied with a current having a frequency in excess of 100 Hz, the electronic ballast shall be incorporated in the luminaire. The luminaire shall comply with the radiated disturbance limits given in table 3.

Additional limits for the electrical component of the disturbing field strength are under consideration.

Where the light output of the luminaire is regulated by an external device, the disturbance voltage at the control terminals shall not exceed the limits given in table 2b.

## 5.6 UV and IR radiation appliances

### 5.6.1 General

Ultraviolet and infrared radiation appliances are appliances used for medical and cosmetic care, for industrial purposes and for instant zone heating.

This subclause (5.6) applies to appliances which are mainly used in the residential environment. For other appliances, CISPR 11 applies.

### 5.6.2 IR radiation appliances

For appliances which only contain mains frequency operated incandescent radiation sources (infrared emitters) and which do not include any active electronic components, the condition of 5.2.2 applies.

### 5.6.3 UV fluorescent lamp appliances

UV appliances using UV lamps identical to those types of fluorescent lamp mentioned in 5.2.3 and operating with a replaceable starter shall comply with the minimum values of insertion loss given in table 1.

### 5.6.4 Other UV and/or IR appliances

UV and IR appliances other than described in 5.6.2 or 5.6.3 shall comply with the mains terminal voltage limits given in table 2a.

Appliances supplying the radiation source(s) with a current having a (modulating) frequency in excess of 100 Hz shall comply with the radiated disturbance limits given in table 3.

Where the radiation of the appliance is regulated by an external device, the disturbance voltage at the control terminals shall not exceed the terminal voltage limits given in table 2b.

## 5.7 Transport lighting

### 5.7.1 General

Light sources are used in transport vehicles for:

- external lighting and signalling purposes;
- lighting of on-board instruments;
- lighting of interior cabins and rooms.

This subclause (5.7) sets requirements for lighting equipment used on board ships and rail vehicles. Lighting equipment used in/on aircraft is subject to special conditions and falls outside the scope of this standard.

NOTE NOTE Requirements for lighting equipment used in road vehicles are dealt with by CISPR subcommittee D.

### 5.7.2 External lighting and signalling

Where devices for lighting or signalling are equipped with incandescent lamps, they are deemed to fulfil all relevant requirements of this standard without further testing. If gas-discharge lamps are used, the lamp and its ballast shall be mounted in one unit, which shall comply with the terminal voltage limits given in table 2a and the radiated disturbance limits given in table 3.

### 5.7.3 Lighting of on-board instruments

Lighting of on-board instruments is considered to be subject to the requirements for the instruments.

### 5.7.4 Lighting of interior cabins and rooms

Equipment for the interior lighting of ships and passenger rail vehicles is considered as indoor lighting equipment and the relevant requirements of 5.2 apply.

## 5.8 Neon and other advertising signs

Limits and method of measurement are under consideration.

## 5.9 Self-contained emergency lighting luminaires

### 5.9.1 General

Luminaires, designed for the purpose of providing emergency lighting in the event of disruption of the mains supply shall be measured in both the mains on mode and emergency mode (mains off) of operation, as detailed in 5.9.2 and 5.9.3.

- Mains on mode: the state of a self-contained emergency luminaire which is ready to operate while the public network supply is on. In the case of a supply failure, the luminaire automatically changes over to the emergency mode.
- Emergency mode: the state of a self-contained emergency luminaire which provides lighting when energized by its internal power source, the public network supply having failed (mains off).

NOTE NOTE The limit and the measurement method of the field strength for the flashing type emergency lighting luminaires utilizing xenon lamps are under consideration.

### **5.9.2 Measurement in the mains on mode, i.e. operating condition prior to the disruption of the mains supply**

The luminaire shall comply with the mains terminal disturbance voltage limits given in table 2a. Where the luminaire supplies the lamp(s) with a current having an operation frequency in excess of 100 Hz, it shall comply with the radiated disturbance limits given in table 3. Where the light output of the luminaire is regulated by an external device, the disturbance voltage at the control terminal shall not exceed the limits given in table 2b.

### **5.9.3 Measurement in emergency mode, i.e. operating condition after disruption of the mains supply**

Luminaires which supply the lamp(s) with a current having an operation frequency in excess of 100 Hz, while in the emergency mode, shall comply with the radiated disturbance limits given in table 3.

## **5.10 Replaceable starters for fluorescent lamps**

Replaceable starters shall either:

- incorporate a capacitor having a value between 0,005  $\mu\text{F}$  and 0,02  $\mu\text{F}$  and which is connected parallel to the contact pins of the starter;
- or comply with the following insertion loss test:
  - the starter is tested in a luminaire according to the instructions of 7.1.4. The manufacturer shall specify the type of the luminaire and associated fitting which shall be used during the test. Over the whole frequency range given in table 1, the insertion loss of the luminaire when measured with the starter to be tested shall be equal to or higher than the insertion loss of the luminaire when tested with a starter fitted with a capacitor having a value of 0,005  $\mu\text{F} \pm 5\%$ ;
- or comply with the following terminal voltage test:
  - the starter is tested in a relevant single lamp luminaire in the highest power circuit for which the starter is designed. The manufacturer shall specify the type of luminaire and associated circuit(s) which are suitable for use with the starter. The measurement instructions of 8.2 apply. The terminal voltage limits of table 2a shall not be exceeded.

## **6 Operating conditions for lighting equipment**

### **6.1 General**

When measurements of disturbances or insertion loss of lighting equipment are being made, the equipment shall be operated under the conditions specified in 6.2 to 6.6.

The special conditions given in clauses 7, 8 and 9 for the different methods of measurement are to be observed additionally, as appropriate.

### **6.2 Lighting equipment**

The lighting equipment is to be tested as delivered by the manufacturer under normal operating conditions, for example, as given in IEC 60598 for luminaires.

### **6.3 Supply voltage and frequency**

The supply voltage shall be within  $\pm 2\%$  of the rated voltage. The nominal frequency of the mains supply shall be as rated for the equipment.

#### **6.4 Ambient conditions**

Measurements shall be carried out in normal laboratory conditions. The ambient temperature shall be within the range 15 °C to 25 °C.

#### **6.5 Lamps**

##### **6.5.1 Type of lamp used**

Terminal disturbance voltage and radiated field measurements shall be carried out with the lamps for which the lighting equipment is designed. Lamps of the highest wattage rating allowed for the lighting equipment shall be used.

##### **6.5.2 Ageing time of lamps**

Measurements shall be carried out with lamps which have been in operation for at least:

- 2 h for incandescent lamps;
- 100 h for fluorescent and other discharge lamps.

##### **6.5.3 Stabilization time of lamps**

Prior to a measurement, the lamp(s) shall be operated until stabilization has been reached. Unless otherwise stated in this standard or specified by the manufacturer, the following stabilization times shall be observed:

- 5 min for incandescent lamps;
- 15 min for fluorescent lamps;
- 30 min for other discharge lamps.

#### **6.6 Replaceable starters**

When IEC 60155 glow-switch starters are used, the capacitor is replaced by a capacitor of  $0,005 \mu\text{F} \pm 5\%$ . The starter shall be retained in its socket, unless otherwise specified. Care shall be taken that it maintains its characteristics over the whole frequency range covered by the measurements.

If the manufacturer fits a capacitor external to the starter, the luminaire is measured as manufactured including the starter capacitor.

### **7 Method of insertion loss measurement**

#### **7.1 Circuits for the measurement of insertion loss**

**7.1.1** For luminaires as described in 5.2.3 and in 5.5.5, the insertion loss is measured as shown in:

- figure 1 for luminaires for linear and U-type fluorescent lamps;
- figure 2 for luminaires for circular fluorescent lamps;
- figure 3 for luminaires for single-capped fluorescent lamps having integrated starters.

Dummy lamps are specified in 7.2.4.

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 insertion loss measurement 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.

**7.1.2** For independent ballasts as described in 5.3.4, the insertion loss shall be measured in the circuit relevant to the ballast to be tested. The ballast shall be mounted together with its dummy lamp and starter on a piece of insulating material, 12 mm  $\pm$  2 mm thick, as shown in figure 6b. This arrangement shall be considered as a luminaire and the relevant conditions of this clause (7) apply.

**7.1.3** UV radiation appliances as described in 5.6.3 are considered as being luminaires and the relevant conditions of this clause (7) apply.

**7.1.4** Replaceable starters when tested in the insertion loss test as described in 5.10 shall be measured in a single lamp luminaire for which the starter is designed. The luminaire shall have a rated voltage equal to the mains voltage or falling within the mains voltage range as indicated on the starter. The same applies to the wattage. The insertion loss shall be measured twice:

- 1) with the starter under test;
- 2) with the starter replaced by a glow-switch starter having a capacitor of 0,005  $\mu$ F  $\pm$  5 % connected over the contact pins.

## **7.2 Measuring arrangement and procedure**

The measuring arrangement consists of the following parts.

### **7.2.1 Radiofrequency generator**

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

### **7.2.2 Balance-to-unbalance transformer**

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

### **7.2.3 Measuring receiver and network**

A 50  $\Omega$ /50  $\mu$ H + 5  $\Omega$  (or 50  $\Omega$ /50  $\mu$ H) artificial mains network (V-network) in conjunction with a measuring receiver, both as specified in CISPR 16-1, shall be used.

### **7.2.4 Dummy lamps**

The dummy lamps which are used in the circuits of figures 1, 2, and 3 simulate the r.f. properties of the fluorescent lamps and are shown in figures 4a, 4b, 4c, 4d, 4e and 4f.

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 noticeably 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.

### 7.2.5 Measuring arrangements

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.

The length of the coaxial connection leads between the luminaire and the measuring network shall not exceed 0,5 m.

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.

### 7.3 Luminaire

With the exception of the possible modification as set out in 6.6 and the replacement of the lamps, the luminaire is measured as manufactured.

Where 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 the insertion loss measured shall be used for comparison with the relevant limit.

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  $\Omega$  (high frequency type).

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

### 7.4 Measurement procedure

**7.4.1** 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.

#### 7.4.2 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 and shall have substantially the same value, i.e. independent of the arrangement of the measuring network. See annex A for the checking of the balance-to-unbalance transformer properties and the saturation effects.

#### 7.4.3 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  $U_2$ .

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

NOTE 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.

**7.4.5** Where it is known that the insertion loss measured according to figures 1 or 2, or for series-operated fluorescent lamps according to 7.3, is a minimum for a given orientation of the dummy lamp(s), measurements may be made for this orientation only (e.g. for a luminaire with a single ballast and with the dummy lamp(s) inserted so that the relevant input terminal is directly connected to the neutral supply terminal of the luminaire). In cases where there is any doubt on this point, measurements shall be made for all possible orientations of the dummy lamp(s).

## **8 Method of measurement of disturbance voltages**

### **8.1 Measuring arrangement and procedure**

#### **8.1.1 Mains terminal voltage measurement**

The disturbance voltage shall be measured at the mains terminals of the lighting equipment by means of the arrangement described in figures 5 and 6 for the relevant type of equipment.

The output terminals of the artificial mains network (V-network) and the terminals a-b shall be positioned  $0,8 \text{ m} \pm 20 \%$  apart and shall be connected by the two power conductors of a flexible three-core cable of 0,8 m length.

#### **8.1.2 Load and control terminal voltage measurement**

A voltage probe shall be used when measuring on the load or control terminals (see figure 5). It contains a resistor having a resistance value of at least  $1\,500 \Omega$  in series with a capacitor with a reactive value negligible to the resistance (in the range 150 kHz to 30 MHz) (see clause 5.2 of CISPR 16-1).

The measuring results shall be corrected according to the voltage division between the probe and the measuring set. For this correction, only the resistive parts of the impedance shall be taken into account.

#### **8.1.3 Light regulation**

If the lighting equipment incorporates a light-regulating control or is controlled by an external device, then the following method shall be applied when measuring the disturbance voltage.

##### **8.1.3.1 At the mains terminals**

An initial survey or scan of the complete frequency range 9 kHz to 30 MHz shall be made with full light output. In addition, at the following frequencies and at all frequencies at which there is a maximum disturbance found in the initial survey, the control setting shall be varied for maximum disturbance while maintaining the maximum load:

9 kHz, 50 kHz, 100 kHz, 160 kHz, 240 kHz, 550 kHz, 1 MHz, 1,4 MHz, 2 MHz, 3,5 MHz, 6 MHz, 10 MHz, 22 MHz, 30 MHz.

##### **8.1.3.2 At the load and/or control terminals**

An initial survey or scan of the complete frequency range 150 kHz to 30 MHz shall be made with full light output. In addition, at the following frequencies and at all frequencies at which there is a maximum disturbance found in the initial survey, the control setting shall be varied for maximum disturbance while maintaining the maximum load:

160 kHz, 240 kHz, 550 kHz, 1 MHz, 1,4 MHz, 2 MHz, 3,5 MHz, 6 MHz, 10 MHz, 22 MHz, 30 MHz.