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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Assessment of lighting equipment related to human exposure to electromagnetic fields

Evaluation d'un équipement d'éclairage relativement à l'exposition humaine aux champs électromagnétiques

IEC 62493:2009

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

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Email: csc@iec.ch
Tél.: +41 22 919 02 11
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ASSESSMENT OF LIGHTING EQUIPMENT RELATED TO HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS

FOREWORD

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International Standard IEC 62493 has been prepared by IEC technical committee 34: Lamps and related equipment.

The text of this standard is based on the following documents:

FDIS	Report on voting
34/133/FDIS	34/137/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

This International Standard establishes a suitable evaluation method for determining the electromagnetic fields in the space around the equipment mentioned in the scope, and defines standardized operating conditions and measurement distances.

This standard is designed to assess, by measurements and/or calculations, electromagnetic (EM) fields and their potential effect on the human body by reference to exposure levels of the general public given by ICNIRP:1998 [1][1)], IEEE C95.1:2005 and IEEE C95.6:2002[2]. The exposure levels with which to comply are basic restrictions (both ICNIRP- and IEEE-based).

NOTE 1 Maximum permissible exposure levels (IEEE-based) or reference levels (ICNRIP-based) are not used.

Based on the lighting equipment operating properties, the frequency range of the applicable basic restrictions can be limited as follows:

- induced current density between 20 kHz to 10 MHz;
- specific absorption rate (SAR) between 100 kHz to 300 MHz;
- power density is outside the scope.

NOTE 2 Operating frequencies of lighting equipment are higher than 20 kHz to avoid audible noise and infrared interference. Frequency contributions above 300 MHz can be neglected.

This standard is not meant to supplant definitions and procedures specified in exposure standards, but it is aimed at supplementing the procedure already specified for compliance with exposure.

The exposure limits given in Annex C (informative) are for information only, do not comprise an exhaustive list and are valid only in certain regions of the world. It is the responsibility of users of this standard to ensure that they use the current version of the limit values specified by the applicable national authorities.

1) Figures in square brackets refer to the Bibliography.

ASSESSMENT OF LIGHTING EQUIPMENT RELATED TO HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS

1 Scope

This International Standard applies to the assessment of lighting equipment related to human exposure to electromagnetic fields. The assessment consists of the induced current density for frequencies from 20 kHz to 10 MHz and the specific absorption rate (SAR) for frequencies from 100 kHz to 300 MHz around lighting equipment.

Included in the scope of this standard are:

– all lighting equipment for general lighting 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; used indoor and/or outdoor. General lighting equipment means all industrial, residential and public and street lighting;

– lighting part for general lighting of multi-function equipment where one of the primary functions of this is illumination;

– independent auxiliaries exclusively for the use with lighting equipment.

Excluded from the scope of this standard are:

– lighting equipment for aircraft and airfields;

– lighting equipment for road vehicles; (except lighting used for the illumination of passenger compartments in public transport)

– lighting equipment for agriculture;

– lighting equipment for boats/vessels;

– photocopiers, slide projectors;

– apparatus for which the requirements of electromagnetic fields are explicitly formulated in other IEC standards;

NOTE The methods described in this standard are not suitable for comparing the fields from different lighting equipment.

This standard does not apply to built-in components for luminaires such as electronic control gear.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

CISPR 15:2005[2)], *Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment*
Amendment 1 (2006)
Amendment 2 (2008)

2) There exists of a consolidated edition 7.2 (2009), including CISPR 15:2005 and its Amendment 1 and Amendment 2.

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

CISPR 16-1-2:, *Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-2: Radio disturbance and immunity measuring apparatus – Ancillary equipment, conducted disturbances*

CISPR 16-4-2:2003, *Specification for radio disturbance and immunity measuring apparatus and methods. Part 4-2: Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements*

IEC 62311:2007, *Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz – 300 GHz)*

IEEE Std C95.1-2005, *IEEE standard for safety levels with respect to human exposure to radio frequency electromagnetic fields, 3 kHz to 300 GHz*

3 Terms, definitions, physical quantities and units

3.1 Terms and definitions

For the purpose of this standard the following terms and definitions will apply, the international accepted SI-units are used throughout the standard.

3.1.1
basic restriction (basic limitations)
restrictions on exposure to time-varying electric, magnetic and electromagnetic fields that are based on established biological effects and including a safety factor. The basic restriction is the maximum level that should not be exceeded under any conditions.

3.1.2
exposure
exposure occurs whenever and wherever a person is subjected to electric, magnetic or electromagnetic fields or to contact currents other than those originating from physiological processes in the body and other natural phenomena.

3.1.3
measurement distance
distance between the lighting equipment and the external surface of the measurement test-head (see Annex A)

3.1.4
measurement point
position and location of the measurement test-head relative to the lighting equipment

3.1.5
lamp control gear
one or more components between the supply and one or more lamps which may serve to transform the supply voltage, limit the current of the lamp(s) to the required value, provide starting voltage and preheating current, prevent cold starting, correct power factor or reduce radio interference

3.1.6
built-in lamp control gear
lamp control gear generally designed to be built into a luminaire, a box, an enclosure or the like and not intended to be mounted outside a luminaire, etc. without special precautions. The

control gear compartment in the base of a road lighting column is considered to be an enclosure

3.1.7
independent lamp control gear
lamp control gear consisting of one or more separate elements so designed that it can be mounted separately outside a luminaire, with protection according to the marking of the lamp control gear and without any additional enclosure. This may consist of a built-in lamp control gear housed in a suitable enclosure that provides all the necessary protection according to its markings

3.1.8
integral lamp control gear
lamp control gear which forms a non-replaceable part of a luminaire and which cannot be tested separately from the luminaire.

3.1.9
ballast
unit inserted between the supply and one or more discharge lamps which by means of inductance, capacitance, or a combination of inductance and capacitance, serves mainly to limit the current of the lamp(s) to the required value. It may also include means for transforming the supply voltage and arrangements that help provide starting voltage and pre-heating current

3.1.10
self-ballasted lamp
unit which can be dismantled without being permanently damaged, provided with a lamp cap and incorporating a light source and additional elements necessary for starting and for stable operating of the light source

3.1.11
d.c. supplied electronic ballast
d.c. to a.c inverter using semiconductor devices which may include stabilizing elements for supplying power to one or more fluorescent lamps

3.1.12
independent electronic converter
lamp control gear consisting of one or more separate elements so designed that it can be mounted separately outside a lighting equipment, with protection according to the marking of the lamp control gear and without any additional enclosure. This may consist of a built-in lamp control gear housed in suitable enclosure that provides all the necessary protection according to its markings

3.2 Physical quantities and units

The physical quantities and units used in this standard are given in Table 1.

Table 1 – Physical quantities and units

Quantity	Symbol	Unit	Dimension
Conductivity	σ	Siemens per meter	S/m
Current density	J	Ampere per square meter	A/m^2
Electric field strength	E	Volt per meter	V/m
Frequency	f	Hertz	Hz
Magnetic field strength	H	Ampère per meter	A/m
Magnetic flux density	B	Tesla	T (Wb/m^2, Vs/m^2)
Power	P	Watt	W
Current	I	Ampere	A

4 Limits

4.1 General

The basic restrictions of the general public of either IEEE C95.1 2005 or ICNIRP 1998 are used, see Annex C.

4.2 Application of limits

Lighting equipment, as described in the scope, complies with this standard if it fulfils all of the following requirements:

- CISPR 15:2005:
  - § 4.3.1: Disturbance voltage mains terminals in the frequency range from 20 kHz to 30 MHz;
  - § 4.4: Radiated electromagnetic disturbances in the frequency range from 100 kHz to 30 MHz;
- CISPR 15:2005, Amendment 1 (2006):
  - § 4.4.2: Radiated electromagnetic disturbances in the frequency range from 30 MHz to 300 MHz;
- the measured (weighted and summarized) induced current density due to the electric field in the frequency range 20 kHz to 10 MHz does not exceed the factor (F) 0,85 as defined in Annex D.

4.3 Lighting equipment deemed to comply without testing

Lighting equipment without electronic control gear is deemed to comply with the requirements of the standard without testing.

All kind of ignitors, starters, switches, dimmers (including phase control units e.g. triac, GTO) and sensors are not considered as electronic control gear.

5 General requirements

5.1 Supply voltage

Measurements shall be carried out within ± 2 % of the maximum rated supply voltage. Equipment which can be operated from an AC- and/or DC supply shall be measured from one AC supply at a single frequency.

5.2 Measurement frequency range

The measurement frequency range considered is from 20 kHz to 10 MHz (see Annex E).

5.3 Ambient temperature

Measurements shall be carried out in the ambient temperature range 15 °C to 25 °C.

5.4 Measurement equipment requirements

An electromagnetic interference (EMI) test receiver or spectrum analyser according to CISPR 16-1-1 is required, with the settings given in Table 2:

Table 2 – Receiver or spectrum analyser settings

Frequency range	B_6 according to CISPR 16-1-1	Measurement time	f_{step}	Detector
20 kHz – 150 kHz	200 Hz	100 ms	220 Hz	Peak
150 kHz – 10 MHz	9 kHz	20 ms	10 kHz	Peak

A "Van der Hoofden" test-head, as depicted in Figure 1, consists of a conducting sphere with an outside diameter of D_{head} = 210 mm ± 5 mm mounted on an insulated (e.g. wood, plastic) support and connected via an ordinary wire to a protection network.

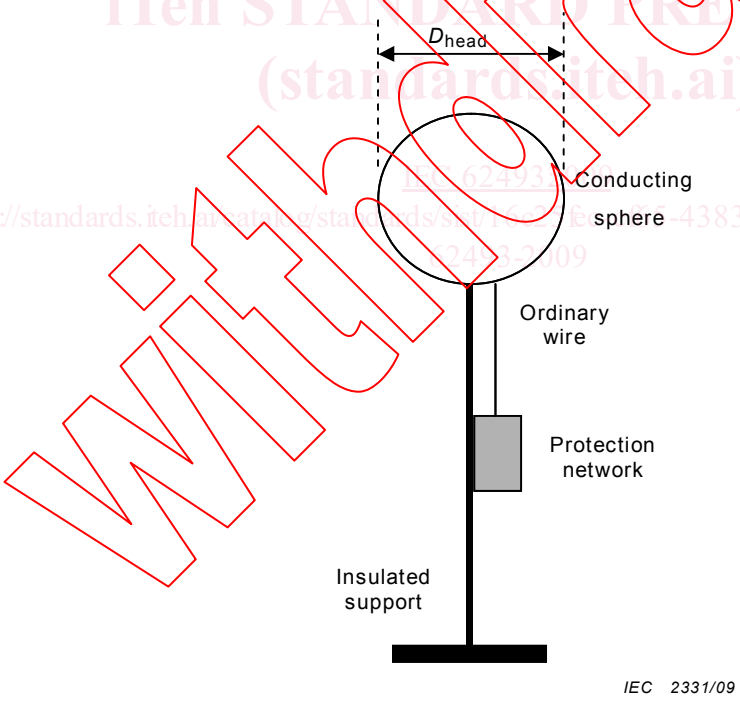
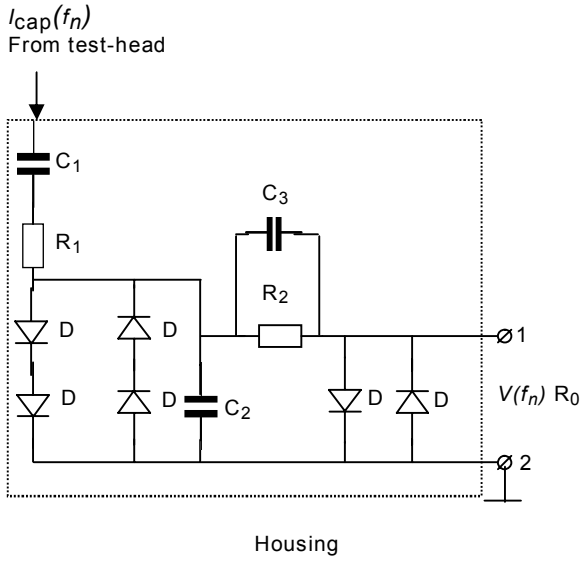


Figure 1 – The "Van der Hoofden" test-head

An example of the protection circuit can be found in Figure 2.



Example

C_1 = 470 pF
C_2 = 10 nF
C_3 = optional capacitor (~56 pF) to fulfill the transfer function requirements of annex F.
R_1 = 470 Ω
R_2 = 150 Ω
D = Schottky diode
R_0 = 50Ω input of EMI receiver

Terminal 1 and 2 have to be connected to EMI receiver of spectrum analyzer via coaxial cable.

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Figure 2 – Example of a protection circuit

The transfer function of the protection network is given by Equation (1)

$$g(fn) = \frac{V(fn)}{i_{cap}(fn)} = \frac{R_0}{\sqrt{1 + [(R_0 + R_2) \cdot 2.\pi \cdot f(n) \cdot C_2]^2}} \quad (1)$$

The transfer function of the protection network shall not deviate more than ± 1 dB from the calculated characteristic (see Annex F for calculation). The calibration of the protection network shall be done according to the procedure described in detail in Annex F.

An overview of the measurement set-up is given in 6.4

5.5 Measurement instrumentation uncertainty

The maximum measurement instrumentation uncertainty (U_{basic}) has been estimated to be 30 %.

See 5.7 on how to handle the measurement uncertainty for evaluating the measurement results. An example for the individual calculation can be found in Annex G.

NOTE Guidance to assess uncertainty can be found in IEC 61786:1998 [4].

5.6 Test report

The test report shall include at least the following items:

– identification of the lighting equipment;
– specification of the measuring equipment;
– operating mode, measurement point(s) and distance(s)
– rated voltage and frequency;
– measurement result;
– applied limit set.

5.7 Evaluation of results

Compliance or non-compliance with the limit shall be determined in the following manner.

If the uncertainty calculated with the instrumentation actually used for the test (U_{lab}) is less or equal than the uncertainty given in 5.5 (U_{basic}) then:

– compliance is deemed if the measurement result does not exceed the applicable limit.

– non-compliance is deemed to occur if the measurement result exceeds the applicable limit.

If the uncertainty calculated with the instrumentation used for the test (U_{lab}) is higher than the uncertainty given in 5.5 (U_{basic}) then:

– compliance is deemed to occur if the measurement result, increased by ($U_{lab} - U_{basic}$), does not exceed the applicable limit.

– non-compliance is deemed to occur if the measurement result, increased by ($U_{lab} - U_{basic}$), exceeds the applicable limit.

6 Measurement procedure

6.1 General

The assessment method is based on basic restrictions given in both ICNIRP 1998 and IEEE C95.1 2005. The measurement procedure used simulates the current density in a person near lighting equipment. The measurements are carried out under the conditions specified in Table A.1 of Annex A.

6.2 Operating conditions

6.2.1 Operating conditions for general lighting equipment

Measurements on the lighting equipment shall be carried out in operating conditions as specified by the manufacturer.

In the case of lighting equipment where it is possible to interchange between lamps of different rated wattage, it is only necessary to measure the lighting equipment in combination with the lamp that has the highest nominal lamp voltage.

Prior to measurement, the lamp(s) shall be operated until stabilisation has been reached. Unless otherwise stated by the manufacturer, the following stabilisation times shall be observed:

– 15 min. for fluorescent lamps;

– 30 min. for other discharge lamps.

All measurements have to be done with 100 h aged lamps.

6.2.2 Operating conditions for specific lighting equipment

Multiple lamp lighting equipment: When the lighting equipment incorporates more than one lamp, all lamps shall be operated simultaneously.

Self-contained emergency lighting equipments: If the appliance can be connected and be operated from the mains it shall be tested in this mode of operation. No tests are required in the battery-operating mode.

Lighting equipment capable of light regulation shall be measured at both the maximum and minimum limit of light regulation.