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REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Energy performance of lamp controlgear –
Part 1: Controlgear for fluorescent lamps – Method of measurement to determine the total input power of controlgear circuits and the efficiency of controlgear

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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International Standard IEC 62442-1 has been prepared by subcommittee 34C: Auxiliaries for lamps, of IEC technical committee 34: Lamps and related equipment.

This second edition cancels and replaces the first edition published in 2011. This edition constitutes a technical revision and has been harmonized with IEC 62442-2 and IEC 624423.

The text of this International Standard is based on the following documents:

CDV	Report on voting
34C/1335A/CDV	34C/1376/RVC

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

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

A list of all parts in the IEC 62442 series, published under the general title *Energy performance of lamp controlgear*, can be found on the IEC website.

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

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- withdrawn,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

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ENERGY PERFORMANCE OF LAMP CONTROLGEAR –

Part 1: Controlgear for fluorescent lamps – Method of measurement to determine the total input power of controlgear circuits and the efficiency of controlgear

1 Scope

This part of IEC 62442 defines a measurement and calculation method of the total input power for controlgear-lamp circuits when operating with their associated fluorescent lamp(s). The calculation method for the efficiency of the lamp controlgear is also defined. This document applies to electrical controlgear-lamp circuits consisting only of the controlgear and the lamp(s). It is intended for use on DC supplies up to 1 000 V and/or AC supplies up to 1 000 V at 50 Hz or 60 Hz.

NOTE Requirements for testing individual controlgear during production are not included.

This document specifies the measurement method for the total input power and the calculation method of the controlgear efficiency for all controlgear used for domestic and normal commercial purposes operating with the following fluorescent lamps:

– linear fluorescent lamps;
– single-ended (compact) fluorescent lamps;
– other general purpose fluorescent lamps.

This document does not apply to:

– controlgear which form an integral part of the lamp;
– controllable wire-wound magnetic controlgear;
– luminaires, which rely on additional optical performance aspects.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

IEC 60081:1997, *Double-capped fluorescent lamps – Performance specifications*
IEC 60081:1997/AMD4:2010

IEC 60901:1996, *Single-capped fluorescent lamps – Performance ~~requirements~~ specifications*
IEC 60901:1996/AMD5:2011

IEC 60921:2004, *Ballasts for tubular fluorescent lamps – Performance requirements*

IEC 60929:2011, *AC and/or DC-supplied electronic control gear for tubular fluorescent lamps – Performance requirements*

IEC 61347-2-3, *Lamp control gear – Part 2-3: Particular requirements for AC and/or DC supplied electronic control gear for fluorescent lamps*

IEC 61347-2-8, *Lamp controlgear – Part 2-8: Particular requirements for ballasts for fluorescent lamps*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
nominal value
suitable approximate quantity value used to designate or identify a component, device or equipment

3.2
limiting value
greatest or smallest admissible value of one of the quantities

3.3
rated value
quantity value for specified operating conditions of a component, device or equipment

Note 1 to entry: The value and conditions are specified in the relevant standard or assigned by the manufacturer or responsible vendor.

Note 2 to entry: For the different kinds of operation, rated electrical values are given on the lamp data sheets as:

- rated electrical values under “electrical characteristics”, if the lamp is defined for 50 Hz/60 Hz operation only,
- rated electrical values under “electrical characteristics”, if the lamp is defined for high frequency (≥ 20 kHz) operation only,
- rated electrical values and typical electrical values, if the lamp is defined simultaneously for 50 Hz/60 Hz operation and high frequency operation
  - for 50 Hz/60 Hz operation: rated electrical values under “electrical characteristics”, and
  - for high frequency operation: rated electrical values under “typical lamp characteristics”.

3.4
controlgear
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

3.5
electromagnetic controlgear
magnetic controlgear
controlgear which, by means of inductance, or a combination of inductance and capacitance, serves mainly to limit the current of the lamp(s) to the required value and operates the lamp(s) at the same frequency as the supply frequency

~~Frequency of the lamp operation is the same as supply frequency.~~

3.6
electronic controlgear
~~a.c. and/or d.c. supplied to~~ AC invertor supplied with alternating current and/or direct current and including stabilizing elements for starting and operating one or more tubular fluorescent lamps, generally at high frequency

3.7
fluorescent lamp
discharge lamp of the low pressure mercury type, in which most of the light is emitted by one or several layers of phosphors excited by the ultra-violet radiation from the discharge

3.8
controlgear-lamp circuit
electrical circuit, or part thereof, normally built in a luminaire, consisting of the controlgear and lamp(s)

3.9
reference ballast
special ballast, either inductive for lamps for operation on AC mains frequencies, or resistive for lamps for operation on high frequency

Note 1 to entry: It is designed for the purpose of providing comparison standards for use in testing ballasts, for the selection of reference lamps and for testing regular production lamps under standardized conditions. It is essentially characterized by the fact that, at its rated frequency, it has a stable voltage/current ratio which is relatively uninfluenced by variations in current, temperature and magnetic surroundings, as outlined in IEC 60929 and IEC 60921.

Note 2 to entry: Annex B provides details for calculating the reference ballast characteristics and the method of operation with the reference ballast.

3.10
reference lamp
lamp selected for testing controlgear which, when associated with a reference controlgear, has electrical characteristics which are close to the rated values or typical lamp characteristics as stated in the relevant lamp standard

Note 1 to entry: For details regarding the tolerances, see Clause B.2.

~~**3.11**~~
~~**rated supply voltage of a controlgear**~~
~~voltage specified by the controlgear manufacturer for a given controlgear that applies to a given operation condition~~

3.11
lamp rated power ~~**of a lamp**~~
P_{Lrated}
power of a given lamp type specified by the manufacturer or the supplier, the lamp being operated under specified conditions

Note 1 to entry: The rated power of a lamp is expressed in W.

3.12
ballast lumen factor
BLF
ratio of the light output of the reference lamp when the ballast under test is operated at its rated voltage, compared with the light output of the same lamp operated with the appropriate reference ballast supplied at its rated voltage and frequency

Note 1 to entry: This note applies to the French language only.

3.13
total input power
total power ~~supplied to~~ consumed by the controlgear-lamp (light source) circuit measured at rated input voltage

~~The rated power specified is related to a specific ballast lumen factor (BLF).~~

[SOURCE: IEC 62442-1:—, 3.13, modified — "supplied to" has been replaced with "consumed by", "(light source)" has been added and the note has been deleted.]

3.14
controlgear efficiency
$\eta_{controlgear}$
~~ratio between the summation of the rated lamp power(s) and the corrected to reference conditions input power of the controlgear – lamp circuit with possible sensors, network connections and other auxiliary loads disconnected~~
ratio of the output power to the lamp(s) and the total input power of the controlgear

Note 1 to entry: Detailed measurement method and conditions are given in Clause 5.

Note 2 to entry: Loads from sensors, network connections and other auxiliary are disconnected or, if not possible, otherwise eliminated from the result.

3.15
multi-power-lamp ~~power~~ controlgear
controlgear designed ~~for the operation of one lamp which could have different lamp power~~ to operate one or more lamp(s) with different rated powers

3.16
multi-number-lamp controlgear
controlgear designed ~~for the operation of~~ to operate simultaneously more than one similar lamp

3.17
standby mode
mode of the controlgear, in which the light source is switched off by a control signal, while the controlgear remains connected to the mains supply, failed lamp(s) not included

Note 1 to entry: The ignition phase of lamp(s) is excluded from the standby mode.

Note 2 to entry: Failed lamp(s) could lead to incorrect measurements.

3.18
standby power
average power consumption of a controlgear in the standby mode

Note 1 to entry: Power supplied by controlgear to sensors, network connections and other auxiliaries is not included in the standby power.

Note 2 to entry: Standby power is expressed in W.

4 General

4.1 Applicability

The measurement and calculation methods in this document shall only be used for controlgear which conforms to IEC 61347-2-3 or IEC 61347-2-8.

4.2 ~~Declaration of~~ Ballast lumen factor

For every controlgear-lamp combination submitted for the test, ~~the controlgear manufacturer shall declare~~ the ~~measured~~ ballast lumen factor shall be measured. The ballast lumen factor is defined in 3.12.

$$BLF = \frac{\text{Light}_{\text{test}}}{\text{Light}_{\text{ref}}} \quad (1)$$

where

$\text{Light}_{\text{ref}}$ is the light output of the reference lamp connected to the reference ballast measured by photocell meter reading;

$\text{Light}_{\text{test}}$ is the light output of the reference lamp connected to the controlgear under test measured by photocell meter reading.

The ~~declared~~ ballast lumen factor shall be in the range of 0,925 to 1,075. A controlgear with a lower ballast lumen factor is not suitable for testing. The upper limit of 1,075 may be exceeded, if the value for maximum lamp operation current and maximum current in any lead to cathodes comply with the rated value in IEC 60081 and IEC 60901.

4.3 Dimmable controlgear

A sufficient cathode temperature shall be produced by the heating circuit at any possible dimming position within the available dimming range of the controlgear as specified in the relevant datasheet in IEC 60081 and IEC 60901.

Dimmable controlgear shall be measured at 100 % and 25 % lumen output of the operated lamp(s).

4.4 Multi-~~wattage~~ power and/or multi-number-lamp controlgear

~~If a controlgear is designed for the operation of one lamp with different lamp power then the test shall be carried out for each lamp type, the manufacturer shall declare for every lamp the relevant BLF. The test for multi-lamp controlgear shall be carried out with all possible combinations.~~

Multi-power and multi-number-lamp controlgear shall be measured with all the possible lamp power and number of lamp combinations. The manufacturer shall declare the relevant BLF for each combination.

~~4.5 Accuracy of measurement~~

~~The accuracy of the measurements shall be in accordance with A.1.2 and A.1.7 of IEC 60929. The total accuracy of the measurement arrangement shall be within ± 1,5 % for magnetic wire-wound controlgear – lamp circuits and ± 2,5 %, for electronic controlgear – lamp circuits, including the accuracy of the photometric measurement.~~

4.5 General notes on tests

The measurement conditions specified in IEC 60921:2004 or IEC 60929:2011, Annex A shall be applied, unless otherwise specified in this document.

For measurement uncertainty and traceability see ISO/IEC Guide 98-3 and IEC Guide 115.

4.6 Sampling of controlgear for testing

~~Tests in this standard are type tests.~~ The requirements and tolerances specified in this document are based on the testing of a type test sample submitted by the manufacturer for

that purpose. This sample should consist of units having characteristics typical of the manufacturer's production and be as close to the production centre point values as possible.

4.7 ~~Number~~ Size of the test sample~~s~~

~~One specimen shall be tested.~~ Tests are carried out with one test specimen.

4.8 Conditioning of lamps

Lamps shall be handled and stabilized as described in IEC 60081:1997 and IEC 60081:1997/AMD4:2010, B.1.1 and in IEC 60901:1996 and IEC 60901:1996/AMD5:2011, B.1.1.

4.9 Test voltages and frequencies

Where the test voltage and frequency are not defined by national or regional requirements, the test voltage and the test frequency shall be the nominal voltage and the nominal frequency of the country or region for which the measurement is being determined ~~± 2 %~~ (refer to Table 1).

Table 1 – Typical nominal electricity supply details for some regions

Country or region	Rated voltage and frequency [a, c]
Europe	230 V, 50 Hz
North America	120 V, 277 V, 60 Hz
Japan [b]	100 V, 200 V, 50/60 Hz
China	220 V, 50 Hz
Australia and New Zealand	230 V, 50 Hz

[a] Values are for single phase only. Some single phase supply voltages can be double the nominal voltage above (centre transformer tap). The voltage between two phases of a three-phase system is 1,73 times single phase values (e.g. 400 V for Europe).

[b] 50 Hz is applicable for the Eastern part and 60 Hz for the Western part~~, respectively~~.

[c] If the manufacturer advises that for a marked voltage range a discrete value shall be used for measurement, this should be observed.

4.10 Sensor and network connections

For the measurement of all kinds of controlgear power (also standby) the power consumed by all circuits (internal or external) which are not involved in power conversion for the controlgear operation (e.g. communication devices, external sensors, auxiliary load, battery charging circuits) shall be excluded from the measurements. If the auxiliary cannot be disconnected, its effect shall be otherwise eliminated from the result.

NOTE Power consumed by circuits necessary for the proper operation of power conversion is considered in the measurement (e.g. cooling fan, signalling lighting).

5 Method of measurement and calculation of total input power of controlgear-lamp circuits and the efficiency of controlgear

5.1 Correction for ballast lumen factor

The total input power measured is corrected to a BLF of 0,95 for wire-wound magnetic controlgear and of 1,00 for high frequency (HF) electronic controlgear. Additionally, tolerances of reference lamps are compensated.

5.2 Method of measurement

The measurements are carried out with the power meter connected to measure the total input power into the controlgear-lamp circuit, using:

– for ~~magnetic wire wound~~ electromagnetic controlgear-lamp circuits:

  the conditions specified in IEC 60921:2004, A.6.1 and the test circuit of Figure A.1;

– for AC supplied electronic controlgear-lamp circuits:

  the conditions specified in IEC 60921:2004, A.6.2, as far as applicable, and the test circuit of Figure A.2.

The value of the total input power ($P_{\text{tot meas}}$) is recorded when a steady state has been reached (controlgear temperature and lamp current stabilized).

The measurements with the controlgear under test in the controlgear-lamp circuit are to be made with the rated supply voltage. P_{Lrated} of a reference lamp, in some cases, may deviate from the nominal value of the lamp.

5.3 Measurement and calculation of the total input power of magnetic ~~wire wound~~ controlgear-lamp circuits

The ~~measured~~ total input power ($P_{\text{tot meas}}$) of a controlgear-lamp circuit is measured with one controlgear and one reference lamp (or the number of reference lamps the controlgear is designed to operate). The reference lamps shall conform to IEC 60921:2004, Annex D; in addition the lamp current shall not deviate from more than 1 % of the rated lamp current.

The measured total input power ($P_{\text{tot meas}}$) is corrected to a BLF of 0,95 and corresponds to that value that would be given by the reference lamp with rated setting in order to minimize the error caused by the variation of the characteristics of the reference lamps used.

The corrected total input power of the ballast-lamp circuit ($P_{\text{tot ref}}$) is calculated using the following Equation (2):

$$P_{\text{tot ref}} = P_{\text{tot meas}} \left(\frac{P_{\text{Lref meas}}}{P_{\text{Lmeas}}} 0{,}95 \right) - \left(P_{\text{Lref meas}} - P_{\text{Lrated}} \right) \quad (2)$$

where

$P_{\text{tot ref}}$ is the total input power of the controlgear-lamp circuit under test corrected to comparable reference conditions (in W);

$P_{\text{tot meas.}}$ is the measured total input power into the controlgear-lamp circuit under test (in W);

$P_{\text{lref meas}}$ is the measured lamp power in the circuit with the reference ballast (in W);

P_{Lmeas} is the measured lamp power in the circuit with the test controlgear (in W);

P_{Lrated} is the rated lamp power of the relevant reference lamp according to the lamp data sheet (in W).

5.4 Calculation of the efficiency of ~~magnetic wire wound~~ electromagnetic controlgear

The ballast lumen factor of 0,95 for the light output of lamps operated with ~~magnetic wire wound~~ electromagnetic controlgear requires the calculation of the efficiency of the magnetic controlgear using Equation (3):

$$\eta_{\text{controlgear}} = \frac{P_{\text{Lrated}}}{P_{\text{tot ref}}} 0{,}95 \tag{3}$$

5.5 Measurement and calculation of the total input power of electronic controlgear-lamp circuits

The ~~measured~~ total input power ($P_{\text{tot meas}}$) of a controlgear-lamp circuit is measured with one controlgear and one reference lamp (or the number of reference lamps the controlgear is designed to operate). The reference lamps shall conform to IEC 60929:2011, Annex C; in addition the lamp current shall not deviate from more than 1 % of the rated lamp current. The measurement setup is described in Annex A.

The comparison between the controlgear circuit with the controlgear under test and the controlgear-lamp circuit with reference ballast in accordance with, as far as applicable, IEC 60921:2004, A.6.1 or A.6.2 is made with the same reference lamp using a photocell positioned as shown in Figure A.4 and Figure A.5 for measuring the light output of the lamp. The measurements are carried out using the test circuit specified in Figure A.1.

~~NOTE~~ Measurement in the Ulbricht sphere is accepted as an alternative to the ones specified in Figure A.3 and Figure A.4. The diameter of the sphere should be at least A + 200 mm. For parameter A, see Figure ~~A.4~~ A.5. In case of doubt, the measurement using the photocell (~~Figure A.3 and Figure A.4~~ Figure A.2) should serve as reference.

NOTE With electronic controlgear, measurements of power losses of the controlgear itself cannot be measured accurately. Therefore, only the total input power method (measuring whole ballast-lamp circuits) can be carried out.

The high frequency lamp current should be obtained with a tolerance of ± 1 % to that specified for the rated current in the lamp standard. At the end of this procedure, the measured high frequency lamp power ($P_{\text{lref meas}}$) shall be within ± 2,5 % of the rated power of the lamp (see electrical characteristics on lamp data sheets).

After reaching stable conditions (controlgear temperature and lamp current stabilized), the measured value with the photocell is set at 100 %.

Under the same test conditions (positioning of the lamp and photocell unchanged), the controlgear under test is connected to the lamp circuit and operated until stable conditions again are reached.

The ratio of the light output of the lamp measured via the photocell, when connected to the controlgear under test, to the light output of the lamp, when connected to the reference ballast, shall be at least 92,5 %.

The total input power ($P_{\text{tot meas}}$) at the supply input of the controlgear under test is then measured.

The measured total input power ($P_{\text{tot meas}}$) into the controlgear-lamp circuit under test is corrected to a BLF of 1,00 ($\text{Light}_{\text{ref}}/\text{Light}_{\text{test}}$) and to minimize the error caused by the variation of the characteristics of the reference lamp used (P_{lrated} / $P_{\text{lref meas}}$). The total input power corrected ($P_{\text{tot ref}}$) of the controlgear-lamp circuit is calculated using the following Equation (4):

$$P_{\text{tot ref}} = P_{\text{tot meas}} \times \frac{P_{\text{Lrated}}}{P_{\text{Lref meas}}} \times \frac{\text{Light}_{\text{ref}}}{\text{Light}_{\text{test}}} \quad (4)$$

where

$P_{\text{tot ref}}$ is the total input power of the controlgear-lamp circuit under test corrected to comparable reference conditions (in W);

$P_{\text{tot meas}}$ is the measured total input power into the controlgear-lamp circuit under test (in W);

P_{Lrated} is the rated lamp or typical HF power of the relevant reference lamp according to the lamp data sheet (in W);

$P_{\text{lref meas}}$ is the measured lamp power in the circuit with reference ballast (in W);

$\text{Light}_{\text{ref}}$ is the light output of the reference lamp connected to the reference ballast measured by photocell meter reading;

$\text{Light}_{\text{test}}$ is the light output of the reference lamp connected to the controlgear under test measured by photocell meter reading.

5.6 Calculation of the efficiency of electronic controlgear

For the calculation of the efficiency of electronic controlgear, Equation (5) should be used:

$$\eta_{\text{controlgear}} = \left(\frac{P_{\text{Lrated}}}{P_{\text{tot ref}}} \right) = \left(\frac{P_{\text{Lref meas}}}{P_{\text{tot meas}}} \times \frac{\text{Light}_{\text{test}}}{\text{Light}_{\text{ref}}} \right) \quad (5)$$

5.7 Measuring the standby power

Standby power is measured for those controlgear which are permanently connected to the mains where the lamps are switched off via a control signal. Other controlgear do not have to be tested. The measurement setup is described in Figure A.3.

Annex A
(normative)

Energy performance measurement setup

A.1 Measurement setup for ~~magnetic wire wound~~ electromagnetic controlgear

For the measurement of the total input power of electromagnetic controlgear and the measurement of the lamp power, the measurement setup of Figure A.1 should be used.

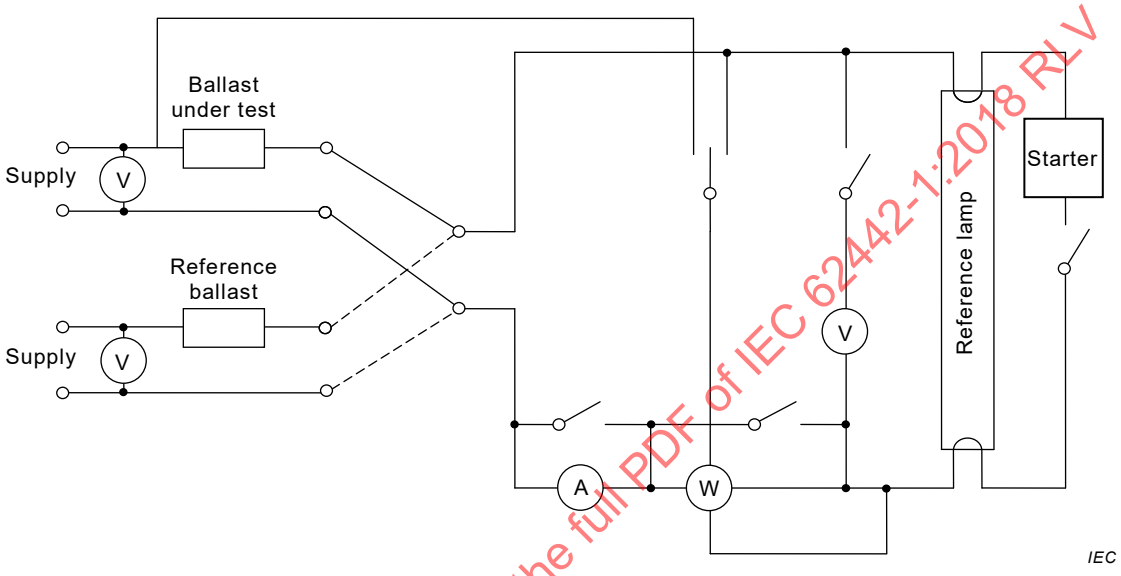


Figure A.1 – Measurement of ~~magnetic wire wound~~ electromagnetic controlgear-lamp circuits

A.2 Measurement setup for electronic controlgear

A.2.1 Measurement of the total input power

For the measurement of the total input power of electronic controlgear, the measurement of the lamp power and the light output, the measurement setup of Figure A.2 should be used.

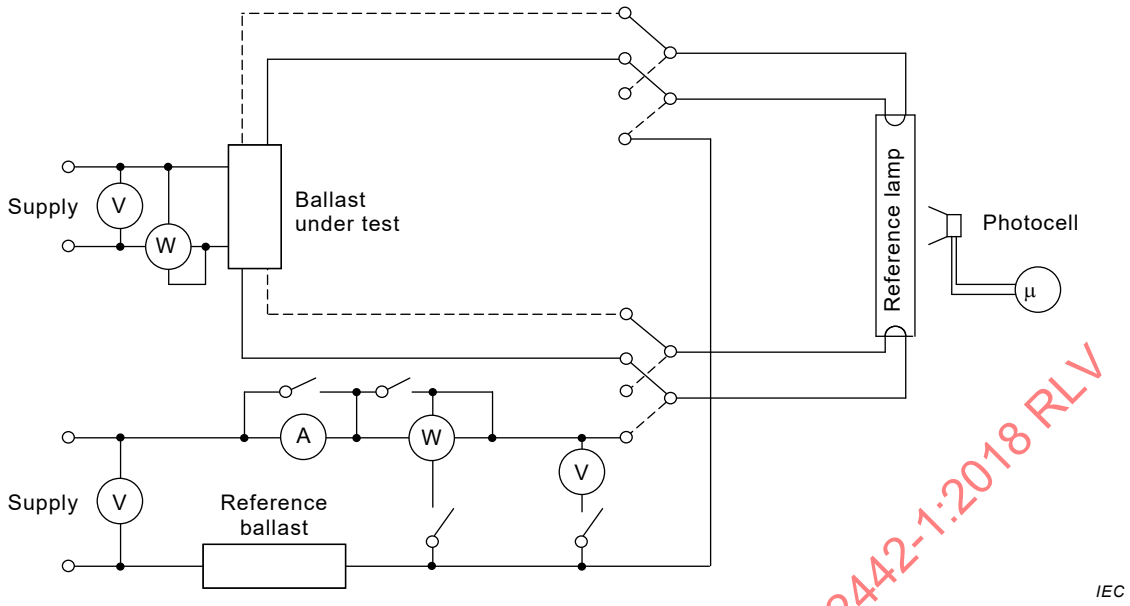


Figure A.2 – Measurement of AC supplied electronic controlgear-lamp circuits

A.2.2 Measuring method of standby power

The controlgear is connected as shown in Figure A.3; for multi-number-lamp controlgear, all lamps are connected. Via the control input, a signal is given to switch the lamps off. After visually checking whether the lamps are switched off, the input power is measured at the rated supply voltage.

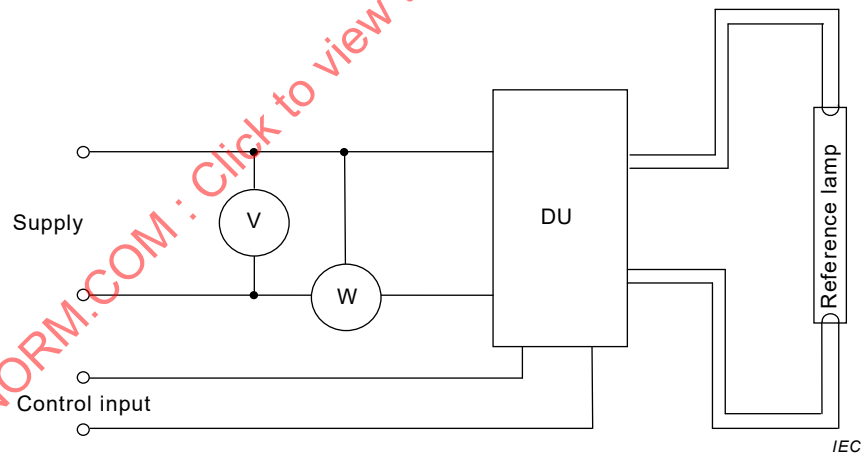


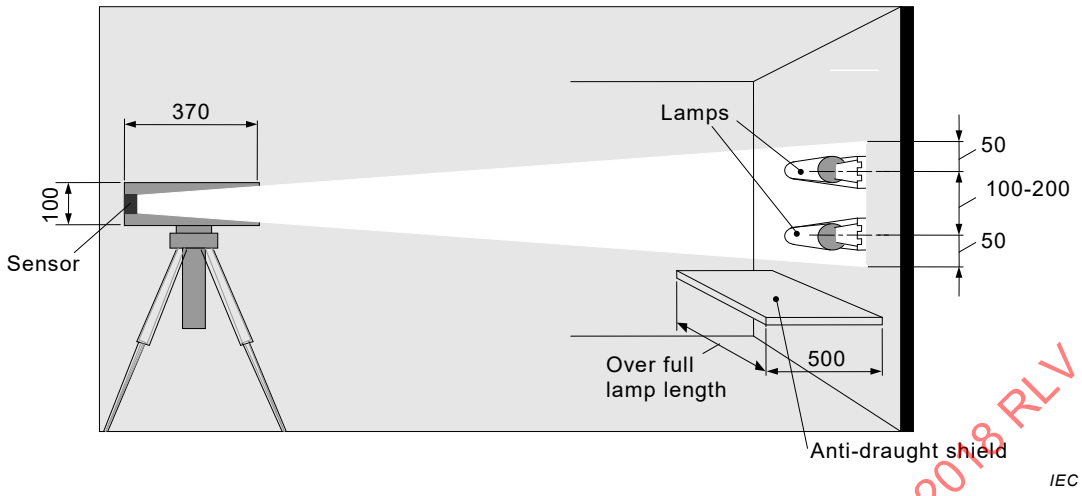
Figure A.3 – Test setup for measuring standby power

A.2.3 Light output measurement

Figure A.4 and Figure A.5 show an example for the light output measurement of fluorescent lamps.

~~NOTE~~ The sensor view angle ~~should~~ shall be large enough to measure the total illuminance of the lamp(s) including the cathodes.

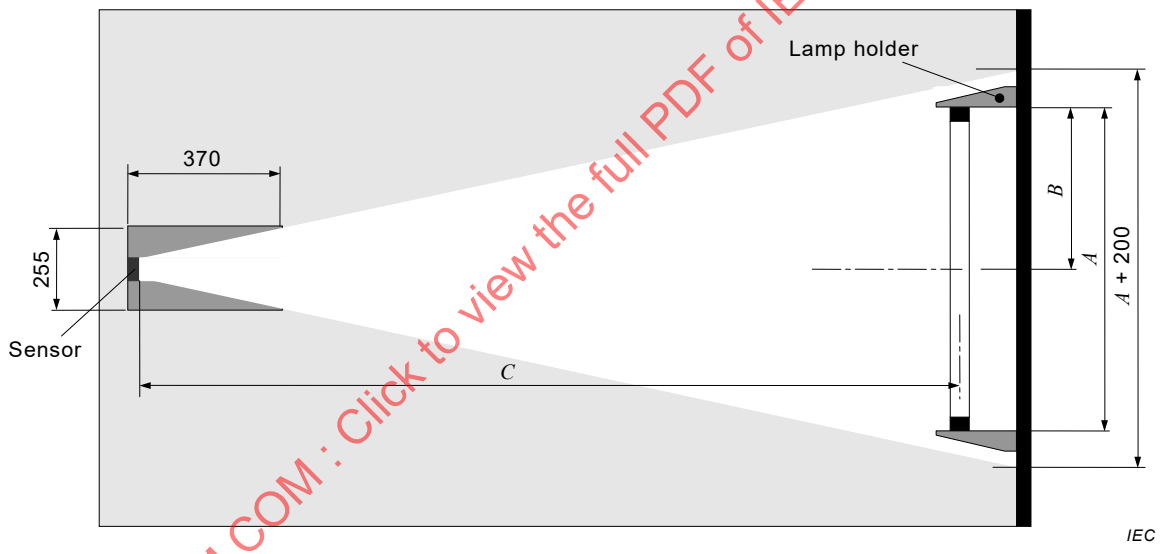
~~NOTE~~ The distance of the sensor to the lamp(s) ~~should~~ shall be at least twice the lamp length in order to ensure that the error, due to the different contributions of light from the centre of the lamp end, is a maximum of 0,3 %.



Dimensions in millimetres

NOTE The sensors are in a box painted matt black internally to avoid reflected light. Lamps are placed horizontally for linear double capped fluorescent lamps. For other lamps, the test position according to the relevant lamp data sheet applies.

Figure A.4 – Side view of light output measurement system



Dimensions in millimetres

Key

A = lamp length

B = 1/2 lamp length

C = 2x lamp length

Figure A.5 – Top view of light output measurement system

Requirements for positioning in Figure A.4 and Figure A.5 are as follows:

a) Figure A.4 and Figure A.5 are used both for single and two-lamp controlgear.

b) The same figures are used also for multi-number-lamp controlgear (three or four lamps) with the following provisions.

- The measuring position of the lamps is for four lamps: two lamps next to each other and two lamps above each other.
- For three-lamp controlgear, the measuring position is in the upper position, two lamps next to each other, and in the lower position, one lamp in the centre.

The minimum distance from the light sensor to the lamp is set at least at 1 m. However the sensor shall cover at least the lamp length plus 20 % of the lamp length.

For an amalgam lamp, ~~care shall be taken that~~ the reference measurements and test measurements ~~are~~ shall always be taken in the same position.

A.2.4 Distance to lamp related to lamp length: explanations

For comparison of the light output measurement with the reference ballast and the light output measurement with the controlgear under test, the light output measurement shall cover the entire lamp surface. HF operation lamps may be operated with 'hot' or with 'cold' electrodes. This will lead to a different light contribution from the lamp ends. It is therefore important that the light from the lamp ends and the light from the middle part of the lamp is weighed equally. The necessary condition is that the sensor is placed at the correct distance from the lamp. This can be achieved by placing the sensor as shown in Figure A.6.

The test position of the lamps shall be in accordance with the given position in the relevant lamp standard IEC 60081 or IEC 60901.

The sensor signal X results from the luminosity Φx from the middle of the lamp, the sensor signal X' results from the luminosity Φx′ from the end of the lamp. The sensor signal resulting from the luminosity of the lamp is proportional to the inverted square of the distance between the sensor and the lamp:

$X = \Phi x / R^2$

$X' = \Phi x' / R'^2 \qquad R' = R / \cos \alpha$

The difference between X and X' resulting from the difference between R and R' shall be minimized. When a lamp is operated with 'cold' electrodes the light contribution from the lamp end will be significantly lower compared with a lamp operated with 'hot' electrodes over a distance of about 2 cm.

This leads to the following result:

$X' = (\Phi x' / R^2) \cos^2 \alpha$

$\cos^2 \alpha > 0{,}95$

$\cos \alpha > 0{,}975 \qquad \alpha < 13°, \qquad \tan \alpha < 0{,}23$

α is 13° ($R = 2L$).

For the sensor, the angle of the incident radiation has no effect on the sensor signal strength (within the 13°), therefore no cos α correction is used for the sensor.

When $R = 2L$, the error due to different contribution in light from the centre of the lamp and the lamp end is maximum 0,3 %.

Figure A.6 shows the relation between X, X', R, R', Φx and Φx′.

NOTE Light output measurements can be done without assistance of an accredited laboratory.

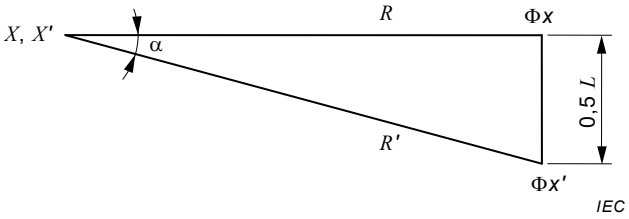


Figure A.6 – Configuration of lamp and photocell sensor

Annex B
(informative)

Application of the reference ballast when assessing lamps in electronic operation

B.1 Calculation of the reference ballast impedance

The characteristics of the high frequency reference ballast for lamps in electronic operation are deduced from the rated lamp voltage and rated lamp current of the relevant lamp data sheet. In order to achieve the rated values of the reference ballast, twice the rated lamp voltage is adjusted to the high frequency power supply. The rated current value, if not given on the lamp data sheet, should be provided by the lamp manufacturer. The value of the low inductance serial resistor is calculated from the rated lamp voltage and the rated lamp current. Definition 3.3 should be regarded in this respect.

B.2 Method of adjusting the lamp power

The reference ballast is represented with a low inductive resistor, which is calculated according to Clause B.1 by taking into consideration definition 3.3.

After stabilization, the HF supply voltage is adjusted until the high frequency lamp current is within a tolerance of ± 1 % to that specified in the lamp standard. At the end of this procedure, the measured high frequency lamp power ($P_{\text{lref meas}}$) shall be within ± 2,5 % of the rated or typical value.

Bibliography

IEC 62442-2, *Energy performance of lamp controlgear – Part 2: Controlgear for high intensity discharge lamps (excluding fluorescent lamps) – Method of measurement to determine the efficiency of the controlgear*[1]

IEC 62442-3, *Energy performance of lamp controlgear – Part 3: Controlgear for tungsten halogen lamps and LED light sources – Method of measurement to determine the efficiency of the controlgear*

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM: 1995)*

IEC Guide 115:2007, *Application of uncertainty of measurement to conformity assessment activities in the electrotechnical sector*

[1] Under consideration.

IEC 62442-1

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Energy performance of lamp controlgear – Part 1: Controlgear for fluorescent lamps – Method of measurement to determine the total input power of controlgear circuits and the efficiency of controlgear

Performance énergétique des appareillages de lampes – Partie 1: Appareillages des lampes à fluorescence – Méthode de mesure pour la détermination de la puissance d'entrée totale des circuits d'appareillage et du rendement des appareillages

IEC 62442-1:2018-05(en-fr)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

ENERGY PERFORMANCE OF LAMP CONTROLGEAR –

Part 1: Controlgear for fluorescent lamps – Method of measurement to determine the total input power of controlgear circuits and the efficiency of controlgear

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International Standard IEC 62442-1 has been prepared by subcommittee 34C: Auxiliaries for lamps, of IEC technical committee 34: Lamps and related equipment.

This second edition cancels and replaces the first edition published in 2011. This edition constitutes a technical revision and has been harmonized with IEC 62442-2 and IEC 62442-3.

The text of this International Standard is based on the following documents:

CDV	Report on voting
34C/1335A/CDV	34C/1376/RVC

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

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

A list of all parts in the IEC 62442 series, published under the general title *Energy performance of lamp controlgear*, can be found on the IEC website.

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

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

ENERGY PERFORMANCE OF LAMP CONTROLGEAR –

Part 1: Controlgear for fluorescent lamps – Method of measurement to determine the total input power of controlgear circuits and the efficiency of controlgear

1 Scope

This part of IEC 62442 defines a measurement and calculation method of the total input power for controlgear-lamp circuits when operating with their associated fluorescent lamp(s). The calculation method for the efficiency of the lamp controlgear is also defined. This document applies to electrical controlgear-lamp circuits consisting only of the controlgear and the lamp(s). It is intended for use on DC supplies up to 1 000 V and/or AC supplies up to 1 000 V at 50 Hz or 60 Hz.

NOTE Requirements for testing individual controlgear during production are not included.

This document specifies the measurement method for the total input power and the calculation method of the controlgear efficiency for all controlgear used for domestic and normal commercial purposes operating with the following fluorescent lamps:

– linear fluorescent lamps;
– single-ended (compact) fluorescent lamps;
– other general purpose fluorescent lamps.

This document does not apply to:

– controlgear which form an integral part of the lamp;
– controllable wire-wound magnetic controlgear;
– luminaires, which rely on additional optical performance aspects.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

IEC 60081:1997, *Double-capped fluorescent lamps – Performance specifications*
IEC 60081:1997/AMD4:2010

IEC 60901:1996, *Single-capped fluorescent lamps – Performance specifications*
IEC 60901:1996/AMD5:2011

IEC 60921:2004, *Ballasts for tubular fluorescent lamps – Performance requirements*

IEC 60929:2011, *AC and/or DC-supplied electronic control gear for tubular fluorescent lamps – Performance requirements*

IEC 61347-2-3, *Lamp control gear – Part 2-3: Particular requirements for AC and/or DC supplied electronic control gear for fluorescent lamps*

IEC 61347-2-8, *Lamp controlgear – Part 2-8: Particular requirements for ballasts for fluorescent lamps*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
nominal value
suitable approximate quantity value used to designate or identify a component, device or equipment

3.2
limiting value
greatest or smallest admissible value of one of the quantities

3.3
rated value
quantity value for specified operating conditions of a component, device or equipment

Note 1 to entry: The value and conditions are specified in the relevant standard or assigned by the manufacturer or responsible vendor.

Note 2 to entry: For the different kinds of operation, rated electrical values are given on the lamp data sheets as:

- rated electrical values under “electrical characteristics”, if the lamp is defined for 50 Hz/60 Hz operation only,
- rated electrical values under “electrical characteristics”, if the lamp is defined for high frequency (≥ 20 kHz) operation only,
- rated electrical values and typical electrical values, if the lamp is defined simultaneously for 50 Hz/60 Hz operation and high frequency operation
  - for 50 Hz/60 Hz operation: rated electrical values under “electrical characteristics”, and
  - for high frequency operation: rated electrical values under “typical lamp characteristics”.

3.4
controlgear
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

3.5
electromagnetic controlgear
magnetic controlgear
controlgear which, by means of inductance, or a combination of inductance and capacitance, serves mainly to limit the current of the lamp(s) to the required value and operates the lamp(s) at the same frequency as the supply frequency

3.6
electronic controlgear
AC invertor supplied with alternating current and/or direct current and including stabilizing elements for starting and operating one or more tubular fluorescent lamps, generally at high frequency

3.7
fluorescent lamp
discharge lamp of the low pressure mercury type, in which most of the light is emitted by one or several layers of phosphors excited by the ultra-violet radiation from the discharge

3.8
controlgear-lamp circuit
electrical circuit, or part thereof, normally built in a luminaire, consisting of the controlgear and lamp(s)

3.9
reference ballast
special ballast, either inductive for lamps for operation on AC mains frequencies, or resistive for lamps for operation on high frequency

Note 1 to entry: It is designed for the purpose of providing comparison standards for use in testing ballasts, for the selection of reference lamps and for testing regular production lamps under standardized conditions. It is essentially characterized by the fact that, at its rated frequency, it has a stable voltage/current ratio which is relatively uninfluenced by variations in current, temperature and magnetic surroundings, as outlined in IEC 60929 and IEC 60921.

Note 2 to entry: Annex B provides details for calculating the reference ballast characteristics and the method of operation with the reference ballast.

3.10
reference lamp
lamp selected for testing controlgear which, when associated with a reference controlgear, has electrical characteristics which are close to the rated values or typical lamp characteristics as stated in the relevant lamp standard

Note 1 to entry: For details regarding the tolerances, see Clause B.2.

3.11
lamp rated power
$P_{\mathbf{Lrated}}$
power of a given lamp type specified by the manufacturer or the supplier, the lamp being operated under specified conditions

Note 1 to entry: The rated power of a lamp is expressed in W.

3.12
ballast lumen factor
BLF
ratio of the light output of the reference lamp when the ballast under test is operated at its rated voltage, compared with the light output of the same lamp operated with the appropriate reference ballast supplied at its rated voltage and frequency

Note 1 to entry: This note applies to the French language only.

3.13
total input power
total power consumed by the controlgear-lamp (light source) circuit measured at rated input voltage

[SOURCE: IEC 62442-1:—, 3.13, modified — "supplied to" has been replaced with "consumed by", "(light source)" has been added and the note has been deleted.]

3.14
controlgear efficiency
$\eta_{\mathbf{controlgear}}$
ratio of the output power to the lamp(s) and the total input power of the controlgear

Note 1 to entry: Detailed measurement method and conditions are given in Clause 5.

Note 2 to entry: Loads from sensors, network connections and other auxiliary are disconnected or, if not possible, otherwise eliminated from the result.

3.15
multi-power-lamp controlgear
controlgear designed to operate one or more lamp(s) with different rated powers

3.16
multi-number-lamp controlgear
controlgear designed to operate simultaneously more than one similar lamp

3.17
standby mode
mode of the controlgear, in which the light source is switched off by a control signal, while the controlgear remains connected to the mains supply, failed lamp(s) not included

Note 1 to entry: The ignition phase of lamp(s) is excluded from the standby mode.

Note 2 to entry: Failed lamp(s) could lead to incorrect measurements.

3.18
standby power
average power consumption of a controlgear in the standby mode

Note 1 to entry: Power supplied by controlgear to sensors, network connections and other auxiliaries is not included in the standby power.

Note 2 to entry: Standby power is expressed in W.

4 General

4.1 Applicability

The measurement and calculation methods in this document shall only be used for controlgear which conforms to IEC 61347-2-3 or IEC 61347-2-8.

4.2 Ballast lumen factor

For every controlgear-lamp combination submitted for the test, the ballast lumen factor shall be measured. The ballast lumen factor is defined in 3.12.

$$BLF = \frac{\text{Light}_{\text{test}}}{\text{Light}_{\text{ref}}} \quad (1)$$

where

$\text{Light}_{\text{ref}}$ is the light output of the reference lamp connected to the reference ballast measured by photocell meter reading;

$\text{Light}_{\text{test}}$ is the light output of the reference lamp connected to the controlgear under test measured by photocell meter reading.

The ballast lumen factor shall be in the range of 0,925 to 1,075. A controlgear with a lower ballast lumen factor is not suitable for testing. The upper limit of 1,075 may be exceeded, if the value for maximum lamp operation current and maximum current in any lead to cathodes comply with the rated value in IEC 60081 and IEC 60901.

4.3 Dimmable controlgear

A sufficient cathode temperature shall be produced by the heating circuit at any possible dimming position within the available dimming range of the controlgear as specified in the relevant datasheet in IEC 60081 and IEC 60901.

Dimmable controlgear shall be measured at 100 % and 25 % lumen output of the operated lamp(s).

4.4 Multi-power and/or multi-number-lamp controlgear

Multi-power and multi-number-lamp controlgear shall be measured with all the possible lamp power and number of lamp combinations. The manufacturer shall declare the relevant BLF for each combination.

4.5 General notes on tests

The measurement conditions specified in IEC 60921:2004 or IEC 60929:2011, Annex A shall be applied, unless otherwise specified in this document.

For measurement uncertainty and traceability see ISO/IEC Guide 98-3 and IEC Guide 115.

4.6 Sampling of controlgear for testing

The requirements and tolerances specified in this document are based on the testing of a type test sample submitted by the manufacturer for that purpose. This sample should consist of units having characteristics typical of the manufacturer's production and be as close to the production centre point values as possible.

4.7 Size of the test sample

Tests are carried out with one test specimen.

4.8 Conditioning of lamps

Lamps shall be handled and stabilized as described in IEC 60081:1997 and IEC 60081:1997/AMD4:2010, B.1.1 and in IEC 60901:1996 and IEC 60901:1996/AMD5:2011, B.1.1.

4.9 Test voltages and frequencies

Where the test voltage and frequency are not defined by national or regional requirements, the test voltage and the test frequency shall be the nominal voltage and the nominal frequency of the country or region for which the measurement is being determined (refer to Table 1).

Table 1 – Typical nominal electricity supply details for some regions

Country or region	Rated voltage and frequency [a, c]
Europe	230 V, 50 Hz
North America	120 V, 277 V, 60 Hz
Japan [b]	100 V, 200 V, 50/60 Hz
China	220 V, 50 Hz
Australia and New Zealand	230 V, 50 Hz

[a] Values are for single phase only. Some single phase supply voltages can be double the nominal voltage above (centre transformer tap). The voltage between two phases of a three-phase system is 1,73 times single phase values (e.g. 400 V for Europe).

[b] 50 Hz is applicable for the Eastern part and 60 Hz for the Western part.

[c] If the manufacturer advises that for a marked voltage range a discrete value shall be used for measurement, this should be observed.

4.10 Sensor and network connections

For the measurement of all kinds of controlgear power (also standby) the power consumed by all circuits (internal or external) which are not involved in power conversion for the controlgear operation (e.g. communication devices, external sensors, auxiliary load, battery charging circuits) shall be excluded from the measurements. If the auxiliary cannot be disconnected, its effect shall be otherwise eliminated from the result.

NOTE Power consumed by circuits necessary for the proper operation of power conversion is considered in the measurement (e.g. cooling fan, signalling lighting).

5 Method of measurement and calculation of total input power of controlgear-lamp circuits and the efficiency of controlgear

5.1 Correction for ballast lumen factor

The total input power measured is corrected to a BLF of 0,95 for wire-wound magnetic controlgear and of 1,00 for high frequency (HF) electronic controlgear. Additionally, tolerances of reference lamps are compensated.

5.2 Method of measurement

The measurements are carried out with the power meter connected to measure the total input power into the controlgear-lamp circuit, using:

– for electromagnetic controlgear-lamp circuits:

  the conditions specified in IEC 60921:2004, A.6.1 and the test circuit of Figure A.1;

– for AC supplied electronic controlgear-lamp circuits:

  the conditions specified in IEC 60921:2004, A.6.2, as far as applicable, and the test circuit of Figure A.2.

The value of the total input power ($P_{\text{tot meas}}$) is recorded when a steady state has been reached (controlgear temperature and lamp current stabilized).

The measurements with the controlgear under test in the controlgear-lamp circuit are to be made with the rated supply voltage. P_{Lrated} of a reference lamp, in some cases, may deviate from the nominal value of the lamp.

5.3 Measurement and calculation of the total input power of magnetic controlgear-lamp circuits

The total input power ($P_{\text{tot meas}}$) of a controlgear-lamp circuit is measured with one controlgear and one reference lamp (or the number of reference lamps the controlgear is designed to operate). The reference lamps shall conform to IEC 60921:2004, Annex D; in addition the lamp current shall not deviate from more than 1 % of the rated lamp current.

The measured total input power ($P_{\text{tot meas}}$) is corrected to a BLF of 0,95 and corresponds to that value that would be given by the reference lamp with rated setting in order to minimize the error caused by the variation of the characteristics of the reference lamps used.

The corrected total input power of the ballast-lamp circuit ($P_{\text{tot ref}}$) is calculated using the following Equation (2):

$$P_{\text{tot ref}} = P_{\text{tot meas}} \left(\frac{P_{\text{Lref meas}}}{P_{\text{Lmeas}}} 0{,}95 \right) - \left(P_{\text{Lref meas}} - P_{\text{Lrated}} \right) \quad (2)$$

where

$P_{\text{tot ref}}$ is the total input power of the controlgear-lamp circuit under test corrected to comparable reference conditions (in W);

$P_{\text{tot meas.}}$ is the measured total input power into the controlgear-lamp circuit under test (in W);

$P_{\text{lref meas}}$ is the measured lamp power in the circuit with the reference ballast (in W);

P_{Lmeas} is the measured lamp power in the circuit with the test controlgear (in W);

P_{Lrated} is the rated lamp power of the relevant reference lamp according to the lamp data sheet (in W).

5.4 Calculation of the efficiency of electromagnetic controlgear

The ballast lumen factor of 0,95 for the light output of lamps operated with electromagnetic controlgear requires the calculation of the efficiency of the magnetic controlgear using Equation (3):

$$\eta_{\text{controlgear}} = \frac{P_{\text{Lrated}}}{P_{\text{tot ref}}} 0{,}95 \quad (3)$$

5.5 Measurement and calculation of the total input power of electronic controlgear-lamp circuits

The total input power ($P_{\text{tot meas}}$) of a controlgear-lamp circuit is measured with one controlgear and one reference lamp (or the number of reference lamps the controlgear is designed to operate). The reference lamps shall conform to IEC 60929:2011, Annex C; in addition the lamp current shall not deviate from more than 1 % of the rated lamp current. The measurement setup is described in Annex A.

The comparison between the controlgear circuit with the controlgear under test and the controlgear-lamp circuit with reference ballast in accordance with, as far as applicable, IEC 60921:2004, A.6.1 or A.6.2 is made with the same reference lamp using a photocell positioned as shown in Figure A.4 and Figure A.5 for measuring the light output of the lamp. The measurements are carried out using the test circuit specified in Figure A.1.

Measurement in the Ulbricht sphere is accepted as an alternative to the ones specified in Figure A.3 and Figure A.4. The diameter of the sphere should be at least A + 200 mm. For parameter A, see Figure A.5 In case of doubt, the measurement using the photocell (Figure A.2) should serve as reference.

NOTE With electronic controlgear, measurements of power losses of the controlgear itself cannot be measured accurately. Therefore, only the total input power method (measuring whole ballast-lamp circuits) can be carried out.

The high frequency lamp current should be obtained with a tolerance of ± 1 % to that specified for the rated current in the lamp standard. At the end of this procedure, the measured high frequency lamp power ($P_{\text{lref meas}}$) shall be within ± 2,5 % of the rated power of the lamp (see electrical characteristics on lamp data sheets).

After reaching stable conditions (controlgear temperature and lamp current stabilized), the measured value with the photocell is set at 100 %.

Under the same test conditions (positioning of the lamp and photocell unchanged), the controlgear under test is connected to the lamp circuit and operated until stable conditions again are reached.

The ratio of the light output of the lamp measured via the photocell, when connected to the controlgear under test, to the light output of the lamp, when connected to the reference ballast, shall be at least 92,5 %.

The total input power ($P_{\text{tot meas}}$) at the supply input of the controlgear under test is then measured.

The measured total input power ($P_{\text{tot meas}}$) into the controlgear-lamp circuit under test is corrected to a BLF of 1,00 ($\text{Light}_{\text{ref}}/\text{Light}_{\text{test}}$) and to minimize the error caused by the variation of the characteristics of the reference lamp used (P_{lrated} / $P_{\text{lref meas}}$). The total input power corrected ($P_{\text{tot ref}}$) of the controlgear-lamp circuit is calculated using the following Equation (4):

$$P_{\text{tot ref}} = P_{\text{tot meas}} \times \frac{P_{\text{Lrated}}}{P_{\text{Lref meas}}} \times \frac{\text{Light}_{\text{ref}}}{\text{Light}_{\text{test}}} \tag{4}$$

where

$P_{\text{tot ref}}$ is the total input power of the controlgear-lamp circuit under test corrected to comparable reference conditions (in W);

$P_{\text{tot meas}}$ is the measured total input power into the controlgear-lamp circuit under test (in W);

P_{Lrated} is the rated lamp or typical HF power of the relevant reference lamp according to the lamp data sheet (in W);

$P_{\text{lref meas}}$ is the measured lamp power in the circuit with reference ballast (in W);

$\text{Light}_{\text{ref}}$ is the light output of the reference lamp connected to the reference ballast measured by photocell meter reading;

$\text{Light}_{\text{test}}$ is the light output of the reference lamp connected to the controlgear under test measured by photocell meter reading.

5.6 Calculation of the efficiency of electronic controlgear

For the calculation of the efficiency of electronic controlgear, Equation (5) should be used:

$$\eta_{\text{controlgear}} = \left(\frac{P_{\text{Lrated}}}{P_{\text{tot ref}}} \right) = \left(\frac{P_{\text{Lref meas}}}{P_{\text{tot meas}}} \times \frac{\text{Light}_{\text{test}}}{\text{Light}_{\text{ref}}} \right) \tag{5}$$

5.7 Measuring the standby power

Standby power is measured for those controlgear which are permanently connected to the mains where the lamps are switched off via a control signal. Other controlgear do not have to be tested. The measurement setup is described in Figure A.3.

Annex A
(normative)

Energy performance measurement setup

A.1 Measurement setup for electromagnetic controlgear

For the measurement of the total input power of electromagnetic controlgear and the measurement of the lamp power, the measurement setup of Figure A.1 should be used.

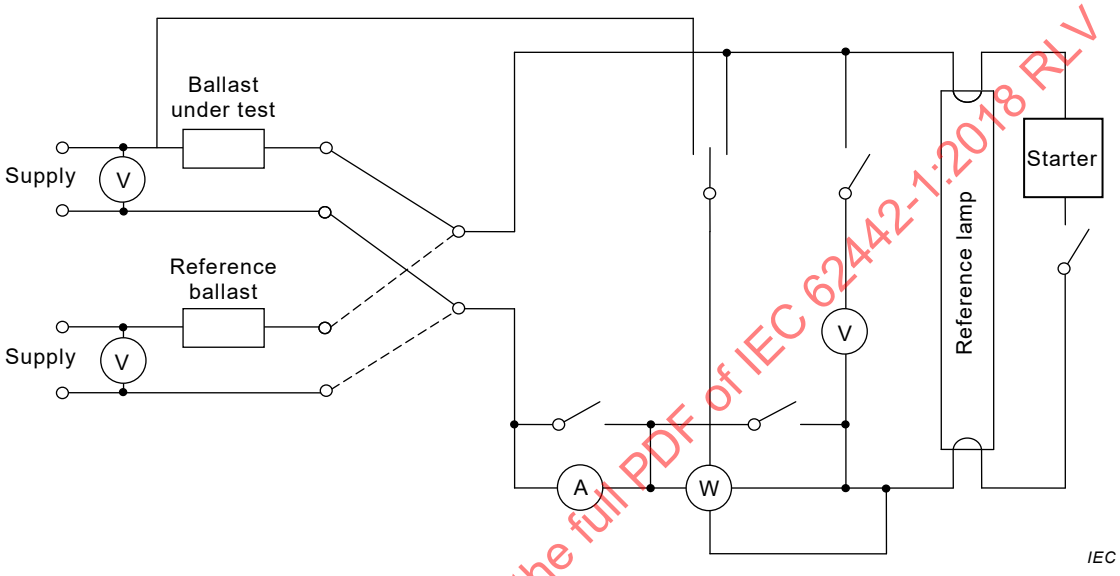


Figure A.1 – Measurement of electromagnetic controlgear-lamp circuits

A.2 Measurement setup for electronic controlgear

A.2.1 Measurement of the total input power

For the measurement of the total input power of electronic controlgear, the measurement of the lamp power and the light output, the measurement setup of Figure A.2 should be used.

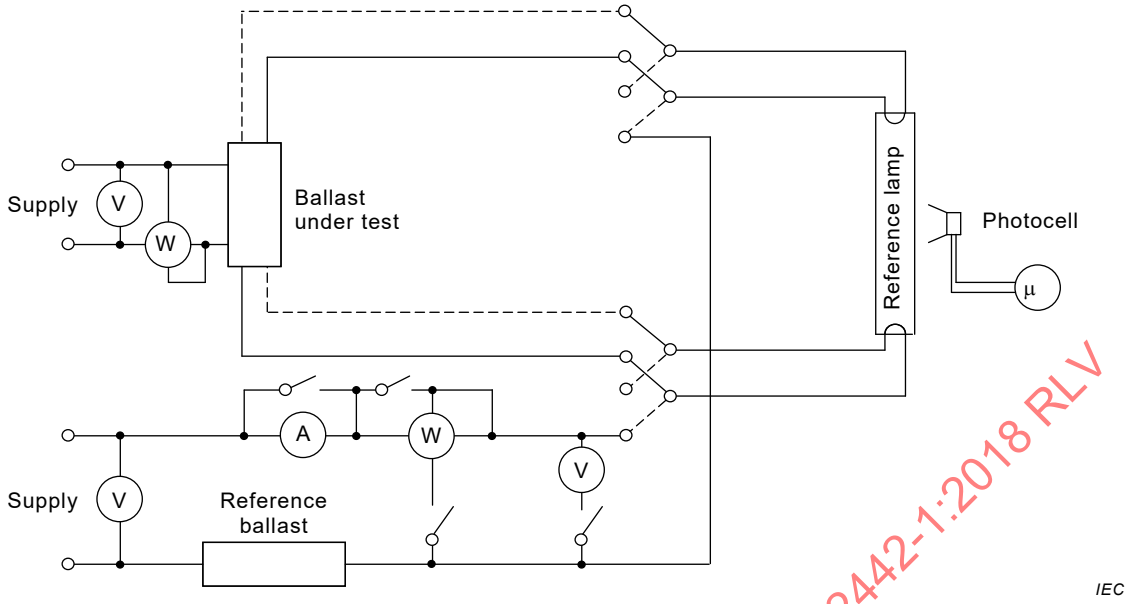


Figure A.2 – Measurement of AC supplied electronic controlgear-lamp circuits

A.2.2 Measuring method of standby power

The controlgear is connected as shown in Figure A.3; for multi-number-lamp controlgear, all lamps are connected. Via the control input, a signal is given to switch the lamps off. After visually checking whether the lamps are switched off, the input power is measured at the rated supply voltage.

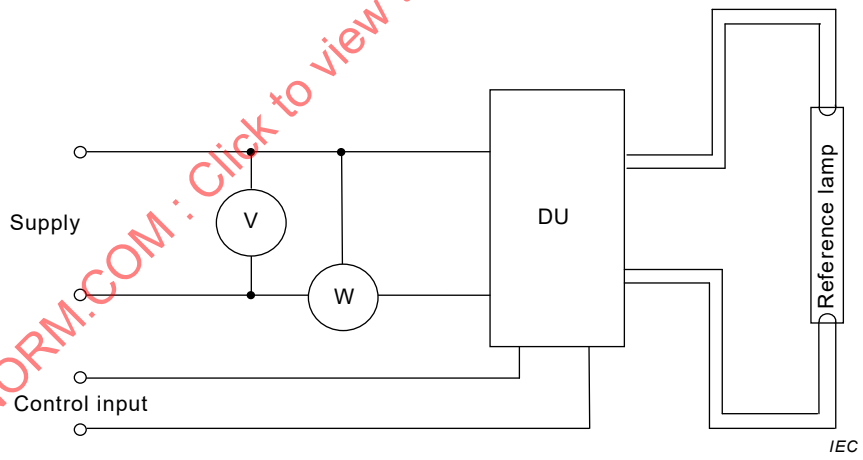


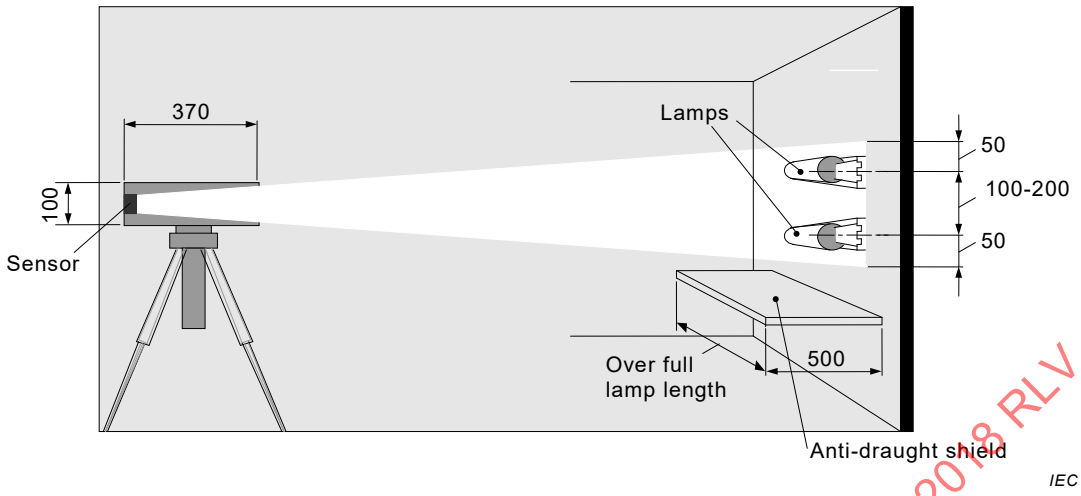
Figure A.3 – Test setup for measuring standby power

A.2.3 Light output measurement

Figure A.4 and Figure A.5 show an example for the light output measurement of fluorescent lamps.

The sensor view angle shall be large enough to measure the total illuminance of the lamp(s) including the cathodes.

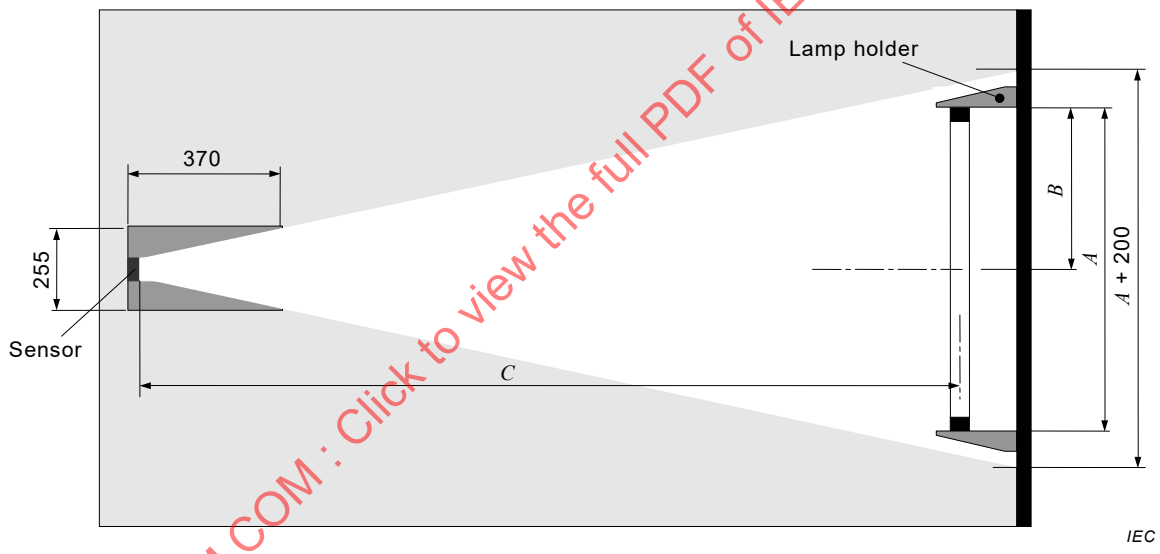
The distance of the sensor to the lamp(s) shall be at least twice the lamp length in order to ensure that the error, due to the different contributions of light from the centre of the lamp end, is a maximum of 0,3 %.



Dimensions in millimetres

NOTE The sensors are in a box painted matt black internally to avoid reflected light. Lamps are placed horizontally for linear double capped fluorescent lamps. For other lamps, the test position according to the relevant lamp data sheet applies.

Figure A.4 – Side view of light output measurement system



Dimensions in millimetres

Key

A = lamp length

B = 1/2 lamp length

C = 2x lamp length

Figure A.5 – Top view of light output measurement system

Requirements for positioning in Figure A.4 and Figure A.5 are as follows:

a) Figure A.4 and Figure A.5 are used both for single and two-lamp controlgear.

b) The same figures are used also for multi-number-lamp controlgear (three or four lamps) with the following provisions.

- The measuring position of the lamps is for four lamps: two lamps next to each other and two lamps above each other.
- For three-lamp controlgear, the measuring position is in the upper position, two lamps next to each other, and in the lower position, one lamp in the centre.

The minimum distance from the light sensor to the lamp is set at least at 1 m. However the sensor shall cover at least the lamp length plus 20 % of the lamp length.

For an amalgam lamp, the reference measurements and test measurements shall always be taken in the same position.

A.2.4 Distance to lamp related to lamp length: explanations

For comparison of the light output measurement with the reference ballast and the light output measurement with the controlgear under test, the light output measurement shall cover the entire lamp surface. HF operation lamps may be operated with 'hot' or with 'cold' electrodes. This will lead to a different light contribution from the lamp ends. It is therefore important that the light from the lamp ends and the light from the middle part of the lamp is weighed equally. The necessary condition is that the sensor is placed at the correct distance from the lamp. This can be achieved by placing the sensor as shown in Figure A.6.

The test position of the lamps shall be in accordance with the given position in the relevant lamp standard IEC 60081 or IEC 60901.

The sensor signal X results from the luminosity Φx from the middle of the lamp, the sensor signal X' results from the luminosity $\Phi x'$ from the end of the lamp. The sensor signal resulting from the luminosity of the lamp is proportional to the inverted square of the distance between the sensor and the lamp:

$X = \Phi x / R^2$

$X' = \Phi x' / R'^2 \qquad R' = R / \cos \alpha$

The difference between X and X' resulting from the difference between R and R' shall be minimized. When a lamp is operated with 'cold' electrodes the light contribution from the lamp end will be significantly lower compared with a lamp operated with 'hot' electrodes over a distance of about 2 cm.

This leads to the following result:

$X' = (\Phi x' / R^2) \cos^2 \alpha$

$\cos^2 \alpha > 0{,}95$

$\cos \alpha > 0{,}975 \qquad \alpha < 13°, \qquad \tan \alpha < 0{,}23$

α is 13° ($R = 2L$).

For the sensor, the angle of the incident radiation has no effect on the sensor signal strength (within the 13°), therefore no cos α correction is used for the sensor.

When $R = 2L$, the error due to different contribution in light from the centre of the lamp and the lamp end is maximum 0,3 %.

Figure A.6 shows the relation between X, X', R, R', Φx and $\Phi x'$.

NOTE Light output measurements can be done without assistance of an accredited laboratory.

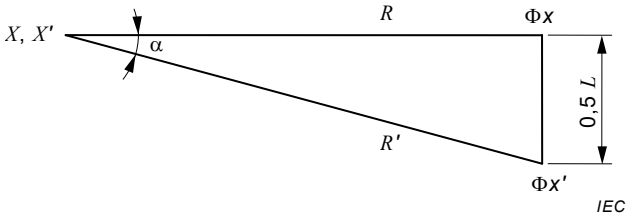


Figure A.6 – Configuration of lamp and photocell sensor

Annex B
(informative)

Application of the reference ballast when assessing lamps in electronic operation

B.1 Calculation of the reference ballast impedance

The characteristics of the high frequency reference ballast for lamps in electronic operation are deduced from the rated lamp voltage and rated lamp current of the relevant lamp data sheet. In order to achieve the rated values of the reference ballast, twice the rated lamp voltage is adjusted to the high frequency power supply. The rated current value, if not given on the lamp data sheet, should be provided by the lamp manufacturer. The value of the low inductance serial resistor is calculated from the rated lamp voltage and the rated lamp current. Definition 3.3 should be regarded in this respect.

B.2 Method of adjusting the lamp power

The reference ballast is represented with a low inductive resistor, which is calculated according to Clause B.1 by taking into consideration definition 3.3.

After stabilization, the HF supply voltage is adjusted until the high frequency lamp current is within a tolerance of ± 1 % to that specified in the lamp standard. At the end of this procedure, the measured high frequency lamp power ($P_{\text{lref meas}}$) shall be within ± 2,5 % of the rated or typical value.

Bibliography

IEC 62442-2, *Energy performance of lamp controlgear – Part 2: Controlgear for high intensity discharge lamps (excluding fluorescent lamps) – Method of measurement to determine the efficiency of the controlgear*

IEC 62442-3, *Energy performance of lamp controlgear – Part 3: Controlgear for tungsten halogen lamps and LED light sources – Method of measurement to determine the efficiency of the controlgear*

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM: 1995)*

IEC Guide 115:2007, *Application of uncertainty of measurement to conformity assessment activities in the electrotechnical sector*

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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PERFORMANCE ÉNERGÉTIQUE DES APPAREILLAGES DE LAMPES –

Partie 1: Appareillages des lampes à fluorescence – Méthode de mesure pour la détermination de la puissance d'entrée totale des circuits d'appareillage et du rendement des appareillages

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La Norme internationale IEC 62442-1 a été établie par le sous-comité 34C: Appareils auxiliaires pour lampes, du comité d'études 34 de l'IEC: Lampes et équipements associés.

Cette deuxième édition annule et remplace la première édition parue en 2011. Cette édition constitue une révision technique et a été harmonisée avec l'IEC 62442-2 et l'IEC 62442-3.

Le texte de cette Norme internationale est issu des documents suivants:

CDV	Rapport de vote
34C/1335A/CDV	34C/1376/RVC

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette Norme internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 62442, publiées sous le titre général *Performance énergétique des appareillages de lampes*, peut être consultée sur le site web de l'IEC.

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PERFORMANCE ÉNERGÉTIQUE DES APPAREILLAGES DE LAMPES –

Partie 1: Appareillages des lampes à fluorescence – Méthode de mesure pour la détermination de la puissance d'entrée totale des circuits d'appareillage et du rendement des appareillages

1 Domaine d'application

La présente partie de l'IEC 62442 définit une méthode de mesure et de calcul de la puissance d'entrée totale pour les circuits d'appareillage-lampe fonctionnant avec la ou les lampes à fluorescence qui leur sont associées. La méthode de calcul du rendement des appareillages de lampe est également définie. Le présent document s'applique aux circuits électriques d'appareillage de lampe constitués exclusivement de l'appareillage et de(s) lampe(s). Il s'applique à des alimentations en courant continu jusqu'à 1 000 V et/ou à des alimentations en courant alternatif de 1 000 V au maximum, à 50 Hz ou 60 Hz.

NOTE Les exigences pour les essais de chaque appareillage pendant la production ne sont pas incluses.

Le présent document spécifie la méthode de mesure de la puissance d'entrée totale et la méthode de calcul du rendement pour tous les appareillages à usage domestique et usage commercial normal, fonctionnant avec les lampes à fluorescence suivantes:

– lampes à fluorescence rectilignes;
– lampes à fluorescence (compactes) à culot unique;
– autres lampes à fluorescence universelles.

Le présent document ne s'applique pas:

– aux appareillages qui font partie intégrante de la lampe;
– aux appareillages magnétiques bobinés commandables;
– aux luminaires soumis à des aspects supplémentaires relatifs aux performances optiques.

2 Références normatives

Les documents suivants cités dans le texte constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60081:1997, *Lampes à fluorescence à deux culots – Prescriptions de performance*
IEC 60081:1997/AMD4:2010

IEC 60901:1996, *Lampes à fluorescence à culot unique – Prescriptions de performances*
IEC 60901:1996/AMD5:2011

IEC 60921:2004, *Ballasts pour lampes tubulaires à fluorescence – Exigences de performances*

IEC 60929:2011, *Appareillages électroniques alimentés en courant alternatif et/ou continu pour lampes tubulaires à fluorescence – Exigences de performances*

IEC 61347-2-3, *Appareillages de lampes – Partie 2-3: Exigences particulières pour les appareillages électroniques alimentés en courant alternatif et/ou en courant continu pour lampes fluorescentes*

IEC 61347-2-8, *Appareillages de lampes – Partie 2-8: Prescriptions particulières pour les ballasts pour lampes fluorescentes*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

3.1
valeur nominale
valeur approchée appropriée d'une grandeur, utilisée pour dénommer ou identifier un composant, un dispositif ou un matériel

3.2
valeur limite
plus grande ou plus petite valeur admissible de l'une des grandeurs

3.3
valeur assignée
valeur d'une grandeur correspondant à des conditions de fonctionnement spécifiées d'un composant, d'un dispositif ou d'un matériel

Note 1 à l'article: La valeur et les conditions sont spécifiées dans la norme applicable, ou attribuées par le fabricant ou le fournisseur compétent.

Note 2 à l'article: Pour les différents types de fonctionnement, les valeurs électriques assignées sont données sur les feuilles de caractéristiques des lampes, de la façon suivante:

- valeurs électriques assignées dans les "caractéristiques électriques", si la lampe est définie pour un fonctionnement à 50 Hz/60 Hz uniquement,
- valeurs électriques assignées dans les "caractéristiques électriques", si la lampe est définie pour un fonctionnement à haute fréquence (≥ 20 kHz) uniquement,
- valeurs électriques assignées et valeurs électriques types, si la lampe est définie simultanément pour un fonctionnement à 50 Hz/60 Hz et pour un fonctionnement à haute fréquence
  - pour un fonctionnement à 50 Hz/60 Hz: valeurs électriques assignées dans les "caractéristiques électriques", et
  - pour un fonctionnement à haute fréquence: valeurs électriques assignées dans les "caractéristiques de lampes types".

3.4
appareillage
composant unique ou ensemble de composants insérés entre l'alimentation et une ou plusieurs lampes, pouvant servir à transformer la tension d'alimentation, limiter le courant de la ou des lampes à la valeur requise, fournir la tension d'amorçage et le courant de préchauffage, empêcher le démarrage à froid, corriger le facteur de puissance, ou réduire les perturbations radioélectriques

3.5
appareillage électromagnétique
appareillage magnétique
appareillage qui, via l'inductance, ou une combinaison de l'inductance et de la capacité, sert principalement à limiter le courant de la ou des lampes à la valeur requise et fait fonctionner la ou les lampes à la même fréquence que la fréquence d'alimentation

3.6
appareillage électronique
onduleur en courant alternatif alimenté en courant alternatif et/ou courant continu et comprenant des éléments de stabilisation pour l'amorçage et le fonctionnement d'une ou plusieurs lampes tubulaires à fluorescence, généralement à haute fréquence

3.7
lampe à fluorescence
lampe à décharge à vapeur de mercure à basse pression dans laquelle la plus grande partie de la lumière est émise par une ou plusieurs couches de substances luminescentes excitées par le rayonnement ultraviolet de la décharge

3.8
circuit d'appareillage-lampe
circuit électrique, ou partie de ce circuit, habituellement intégré à un luminaire, comprenant l'appareillage et la ou les lampes

3.9
ballast de référence
ballast spécial, qui est soit inductif pour les lampes pour fonctionnement aux fréquences du réseau courant alternatif, soit résistif pour les lampes pour fonctionnement à haute fréquence

Note 1 à l'article: Il est conçu pour fournir un élément normalisé de comparaison pour l'essai des ballasts, pour la sélection des lampes de référence et pour le contrôle des lampes en cours de production, dans des conditions normalisées. Il est caractérisé essentiellement, à sa fréquence assignée, par un rapport tension/courant stable qui n'est relativement pas influencé par les variations de courant, de température et de l'environnement magnétique, comme indiqué dans l'IEC 60929 et l'IEC 60921.

Note 2 à l'article: L'Annexe B fournit des détails relatifs au calcul des caractéristiques du ballast de référence et à la méthode de fonctionnement avec le ballast de référence.

3.10
lampe de référence
lampe sélectionnée en vue de l'essai d'un appareillage et qui, lorsqu'elle est associée à un appareillage de référence, présente des caractéristiques électriques qui se rapprochent des valeurs assignées ou des caractéristiques de lampes types définies dans la norme relative à la lampe concernée

Note 1 à l'article: Pour les détails concernant les tolérances, voir l'Article B.2.

3.11
puissance assignée d'une lampe
$P_{\text{Lassignée}}$
puissance d'un type de lampe donné spécifié par le fabricant ou le fournisseur et fonctionnant dans des conditions spécifiées

Note 1 à l'article: La puissance assignée d'une lampe est exprimée en W.

3.12
facteur de flux lumineux d'un ballast
BLF
rapport du flux lumineux d'une lampe de référence lorsque le ballast soumis à essai fonctionne à sa tension assignée, comparé au flux lumineux de la même lampe fonctionnant avec le ballast de référence approprié, alimenté à sa tension et à sa fréquence assignées

Note 1 à l'article: Le terme abrégé "BLF" est dérivé du terme anglais correspondant "ballast lumen factor".

3.13
puissance d'entrée totale
puissance totale consommée par le circuit d'appareillage-lampe (source lumineuse), mesurée à la tension d'entrée assignée

[SOURCE: IEC 62442-1:—, 3.13, modifiée — "fournie au" a été remplacé par "consommée par", "(source lumineuse)" a été ajouté et la note a été supprimée.]

3.14
rendement de l'appareillage
$\eta_{appareillage}$
rapport de la puissance de sortie de la ou des lampes et de la puissance d'entrée totale de l'appareillage

Note 1 à l'article: La méthode et les conditions de mesure détaillées sont indiquées dans l'Article 5.

Note 2 à l'article: Les charges des capteurs, des connexions réseau et autre auxiliaire sont déconnectées ou, si cela n'est pas possible, elles sont éliminées d'une autre manière du résultat.

3.15
appareillage multipuissance de lampe
appareillage conçu pour faire fonctionner une ou plusieurs lampes avec différentes puissances assignées

3.16
appareillage multilampe
appareillage conçu pour faire fonctionner simultanément plus d'une lampe de type similaire

3.17
mode veille
mode de l'appareillage dans lequel la source lumineuse est éteinte par un signal de commande, tandis que l'appareillage reste branché au réseau, en excluant la ou les lampes défectueuses

Note 1 à l'article: La phase d'allumage de la ou des lampes est exclue du mode veille.

Note 2 à l'article: La ou les lampes défectueuses seraient susceptibles de donner des mesures incorrectes.

3.18
puissance de veille
consommation de puissance moyenne d'un appareillage en mode veille

Note 1 à l'article: La puissance fournie par les appareillages aux capteurs, connexions réseau et autres auxiliaires n'est pas incluse dans la puissance de veille.

Note 2 à l'article: La puissance de veille est exprimée en W.

4 Généralités

4.1 Applicabilité

Les méthodes de mesure et de calcul spécifiées dans le présent document doivent uniquement être utilisées pour les appareillages conformes à l'IEC 61347-2-3 ou l'IEC 61347-2-8.

4.2 Facteur de flux lumineux du ballast

Pour chaque combinaison d'appareillage et de lampe soumise à essai, le facteur du flux lumineux du ballast doit être mesuré. Le facteur du flux lumineux du ballast est défini en 3.12.

$$BLF = \frac{\text{Lumière}_{\text{essai}}}{\text{Lumière}_{\text{réf}}} \quad (1)$$

où

$\text{Lumière}_{\text{réf}}$ est le flux lumineux de la lampe de référence branchée au ballast de référence, relevé au compteur à cellule photoélectrique;

$\text{Lumière}_{\text{essai}}$ est le flux lumineux de la lampe de référence branchée à l'appareillage soumis à essai, relevé au compteur à cellule photoélectrique.

Le facteur de flux lumineux du ballast doit être compris dans une plage de 0,925 à 1,075. Un appareillage avec un facteur de flux lumineux du ballast inférieur ne convient pas à l'essai. La limite supérieure de 1,075 peut être dépassée si la valeur maximale du courant de fonctionnement de la lampe et la valeur maximale du courant passant dans n'importe quel fil relié aux cathodes sont conformes à la valeur assignée spécifiée dans l'IEC 60081 et l'IEC 60901.

4.3 Appareillages à intensité variable

Une température de cathode suffisante doit être délivrée par le circuit de chauffage à toutes les gradations d'intensité possibles dans la plage de gradation disponible pour l'appareillage, tel que spécifié dans la feuille de caractéristiques correspondante dans l'IEC 60081 et l'IEC 60901.

Les appareillages à intensité variable doivent être mesurés à des flux lumineux de 100 % et de 25 % de la ou des lampes en fonctionnement.

4.4 Appareillages multipuissances et/ou multilampes

Les appareillages multipuissances et multilampes doivent être mesurés avec toutes les combinaisons possibles de puissance et de nombre de lampes. Le fabricant doit déclarer le facteur de flux lumineux de ballast applicable à chaque combinaison.

4.5 Notes générales sur les essais

Les conditions de mesure spécifiées dans l'IEC 60921:2004 ou l'IEC 60929:2011, Annexe A doivent être appliquées, sauf indication contraire dans le présent document.

Pour l'incertitude de mesure et la traçabilité, voir le Guide ISO/IEC 98-3 et le Guide IEC 115.

4.6 Echantillonnage des appareillages pour les essais

Les exigences et les tolérances spécifiées dans le présent document se rapportent à l'essai d'un échantillon d'essai de type, présenté en tant que tel par le fabricant. Il convient que cet échantillon soit constitué d'unités présentant des caractéristiques typiques de la production du fabricant, et qu'il soit aussi proche que possible des valeurs médianes de la production.

4.7 Taille de l'échantillon d'essai

Les essais sont réalisés avec un échantillon d'essai.

4.8 Conditionnement des lampes

Les lampes doivent être manipulées et stabilisées comme décrit dans l'IEC 60081:1997, l'IEC 60081:1997/AMD4:2010, B.1.1, dans l'IEC 60901:1996 et l'IEC 60901:1996/AMD5:2011, B.1.1.