

# 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 the 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**



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## 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 the 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.

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

FDIS	Report on voting
34C/987/FDIS	34C/996/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.

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

This standard has been drafted in response to support classification systems for lamp controlgear.

Consideration is being given to include in a future edition of this standard:

- Controlgear – high intensity discharge (HID) lamp circuits;
- Transformer or step-down converter – low voltage halogen lamp circuits;

The committee has decided that the contents of this publication will remain unchanged until the stability 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

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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 the 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 International Standard applies to electrical controlgear lamp circuits consisting only of the controlgear and the lamp(s). It is intended for use on a.c. supplies up to 1 000 V at 50 Hz or 60 Hz.

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

It 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 International Standard 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 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.

IEC 60081, *Double-capped fluorescent lamps – Performance specifications*

IEC 60901, *Single-capped fluorescent lamps – Performance requirements*

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 a.c. and/or d.c. 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.

#### 3.1

##### **nominal value**

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

#### 3.2

##### **limiting value**

the 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

The value and conditions are specified in the relevant standard or assigned by the manufacturer or responsible vendor

NOTE 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 ( $\geq 20$  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**

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

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

#### 3.6

##### **electronic controlgear**

a.c. and/or d.c. supplied to a.c. inverter 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 a.c. mains frequencies, or resistive for lamps for operation on high frequency

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.

NOTE Annex B provides details of 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

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

### 3.12 rated power of a lamp

$P_{Lrated}$   
power, expressed in watts, of a given lamp type specified by the manufacturer or the supplier, the lamp being operated under specified conditions

### 3.13 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

### 3.14 total input power

total power supplied to the controlgear – lamp circuit measured at rated input voltage

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

### 3.15 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

### 3.16 multi-lamp-power controlgear

controlgear designed for the operation of one lamp which could have different lamp power

### 3.17 multi-number-lamp controlgear

controlgear designed for the operation of more than one lamp

## 4 General

### 4.1 Applicability

The measurement and calculation methods of this standard 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. The ballast lumen factor is defined in 3.13.

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

where

$\text{Light}_{\text{ref}}$  is the light output of reference lamp connected to 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 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

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 by 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 and/or multi-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.

### 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  $\pm 1,5$  % for magnetic wire-wound controlgear – lamp circuits and  $\pm 2,5$  %, for electronic controlgear – lamp circuits, including the accuracy of the photometric measurement.

### 4.6 Sampling of controlgear for testing

Tests in this standard are type tests. The requirements and tolerances specified in this standard 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 of samples

One specimen shall be tested.

#### 4.8 Conditioning of lamps

Lamps shall be handled and stabilized as described in B.1.1 of IEC 60081 and B.1.1 of IEC 60901.

#### 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  $\pm 2\%$  (refer to Table 1).

**Table 1 – Typical nominal electricity supply details for some regions**

Country or region	Rated voltage and frequency <sup>a, c</sup>
Europe	230 V, 50 Hz
North America	120 V, 277 V, 60 Hz
Japan <sup>b</sup>	100 V, 50/60 Hz
China	220 V, 50 Hz
Australia and New Zealand	230 V, 50 Hz
<sup>a</sup> 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). <sup>b</sup> "50 Hz" is applicable for the Eastern part and "60 Hz" for the Western part, respectively. <sup>c</sup> "If the manufacturer advises that for a marked voltage range a discrete value shall be used for measurement, this should be observed."	

### 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 controlgear – lamp circuits:  
the conditions specified in A.6.1 of IEC 60921:2004 and the test circuit of Figure A.1;
- for a.c. supplied electronic controlgear – lamp circuits:  
the conditions specified in A.6.2 of IEC 60921:2004, 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 ( $P_{tot.meas.}$ ) of a controlgear – lamp circuit is measured with one controlgear and a reference lamp (or the number of reference lamps the controlgear is designed to operate). The reference lamps shall conform to Annex D of IEC 60921:2004, in addition the lamp current shall not deviate more than 1 % of the rated lamp current.

The measured total input power ( $P_{tot.meas.}$ ) 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 ( $P_{tot.ref.}$ ) is calculated using the following equation (2):

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

where

$P_{tot.ref.}$  is the total input power of the controlgear – lamp circuit under test corrected to comparable reference conditions (in watts);

$P_{tot.meas.}$  is the measured total input power into the controlgear – lamp circuit under test (in watts);

$P_{Lref.meas.}$  is the measured lamp power in the circuit with reference ballast (in watts);

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

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

### 5.4 Calculation of the efficiency of magnetic wire wound controlgear

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

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

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

The measured total input power ( $P_{tot.meas.}$ ) 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 Annex C of IEC 60929:2011, in addition the lamp current shall not deviate more than 1 % of the rated lamp current.

The comparison between the controlgear circuit with the controlgear under test and the controlgear – lamp circuit with reference ballast in accordance with A.6.1 or A.6.2, as far as applicable, of IEC 60921:2004 is made with the same reference lamp using a photocell positioned as shown in Figures 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 1 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.

NOTE 2 Measurement in the Ulbricht sphere is accepted as an alternative to the ones prescribed 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. In case of doubt, the measurement using photocell (Figure A.3 and Figure A.4) should serve as reference.

The high frequency lamp current should be obtained with a tolerance of  $\pm 1\%$  to that specified to the rated current in the lamp standard. At the end of this procedure, the measured high frequency lamp power ( $P_{Lref.meas.}$ ) shall be within  $\pm 2,5\%$  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 ( $P_{tot.meas.}$ ) at the supply input of the controlgear under test is then measured.

The measured total input power ( $P_{tot.meas.}$ ) into the controlgear – lamp circuit under test is corrected to a BLF of 1,00 ( $Light_{ref.}/Light_{test}$ ) and to minimize the error caused by the variation of the characteristics of the reference lamp used ( $P_{Lrated.}/P_{Lref.meas.}$ ). The total input power corrected ( $P_{tot.ref.}$ ) of the controlgear – lamp circuit is calculated using the following equation (4):

$$P_{tot.ref.} = P_{tot.meas.} \times \frac{P_{Lrated.}}{P_{Lref.meas.}} \times \frac{Light_{ref.}}{Light_{test}} \quad (4)$$

where

$P_{tot.ref.}$  is the total input power of the controlgear – lamp circuit under test corrected to comparable reference conditions (in watts);

$P_{tot.meas.}$  is the measured total input power into the controlgear – lamp circuit under test (in watts);

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

$P_{Lref.meas.}$  is the measured lamp power in circuit with reference ballast (in watts);

$Light_{ref.}$  is the light output of reference lamp connected to reference ballast measured by photocell meter reading;

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

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 1.

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