IEC 61228

Edition 3.0 2020-11
REDLINE VERSION

INTERNATIONAL STANDARD

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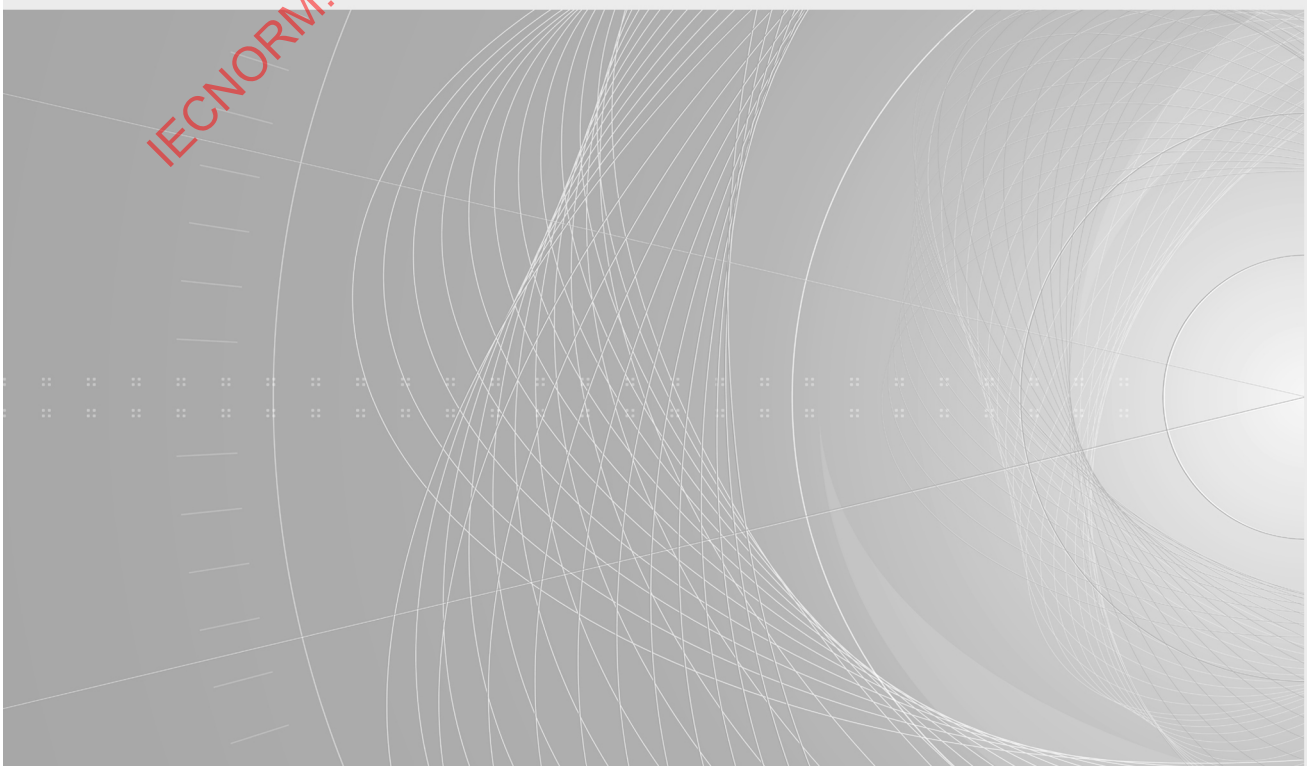
Fluorescent ultraviolet lamps used for tanning – Measurement and specification method



IEC 61228:2020-11 RLV(en)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 17.240; 29.140.01; 97.170

ISBN 978-2-8322-9041-5

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FLUORESCENT ULTRAVIOLET LAMPS USED FOR TANNING – MEASUREMENT AND SPECIFICATION METHOD

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 61228 has been prepared by subcommittee 34A: Electric light sources, of IEC technical committee 34: Lighting.

This third edition cancels and replaces the second edition published in 2008. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) maintenance code: description of the depreciation of the UV irradiance lamp during operation;
b) operating position: information added for single capped lamps;
c) spectroradiometric measuring system: new information about distance between sensor and lamp axis;
d) measurement and evaluation procedure: separated detailed information for double capped fluorescent UV lamps and single capped fluorescent UV lamps;
e) Annex C (normative), Method of test for irradiance maintenance: new information added;
f) Annex D (normative), Reflector gauge: new information added;
g) Annex E (normative), Lamp datasheets for measurement: complementary information added.

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

FDIS	Report on voting
34A/2213/FDIS	34A/2220/RVD

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.

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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FLUORESCENT ULTRAVIOLET LAMPS USED FOR TANNING – MEASUREMENT AND SPECIFICATION METHOD

1 Scope

This document describes the method of measuring, evaluating and specifying the UV irradiation characteristics of fluorescent ultraviolet lamps that are used in appliances for tanning purposes. It includes specific requirements regarding the marking of such lamps.

These ~~recommendations~~ requirements relate only to type testing.

Lamps complying with the requirements of this document comply with the electrical and mechanical safety requirements of IEC 61195 and IEC 61199 with the exception of the requirements for maximum limits of UV radiation.

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 60050-845:1987, *International Electrotechnical Vocabulary (IEV) – Chapter 845: Lighting*~~

IEC 60061-1, *Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 1: Lamp caps*

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

IEC 60155, *Glow-starters for fluorescent lamps*

~~IEC 60901, *Single-capped fluorescent lamps – Performance specifications*~~

IEC 60335-2-27, *Household and similar electrical appliances – Safety – Part 2-27: Particular requirements for appliances for skin exposure to ~~ultraviolet and infrared~~ optical radiation*

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

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

IEC 61049, *Capacitors for use in tubular fluorescent and other discharge lamp circuits. Performance requirements*

ISO/CIE 28077:2016, *Photocarcinogenesis action spectrum (non-melanoma skin cancers)*

CIE 63:1984, *The spectroradiometric measurement of light sources*

~~IEC 62471, *Photobiological safety of lamps and lamp systems*~~

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
ultraviolet lamp
lamp which radiates especially strongly in the ultraviolet, the visible radiation produced, if any, not being of direct interest

[SOURCE: IEC 60050-845:1987, 845-07-52, modified – Note deleted.]

3.2
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 ultraviolet radiation from the discharge

[SOURCE: IEC 60050-845:1987, 845-07-26, modified – Note deleted.]

~~**3.3**~~
~~**type test**~~
~~test or a series of tests made on a type test sample for the purpose of checking compliance of the design of a given product with the requirements of the relevant standard~~

3.3
spectroradiometer
instrument for measuring radiometric quantities in narrow wavelength intervals over a given spectral region

[SOURCE: IEC 60050-845:1987, 845-05-07]

3.4
bandwidth at a given wavelength
width at half-amplitude points of the transmittance function of a monochromator

Note 1 to entry: The bandwidth is expressed in nm.

3.5
spectral
adjective that, when applied to a quantity X pertaining to electromagnetic radiation, indicates:

– either that X is a function of the wavelength λ, symbol: $X(\lambda)$;
– or that the quantity referred to is the spectral concentration of X, symbol: $X_\lambda = \mathrm{d}X/\mathrm{d}\lambda$.

X_λ is also a function of λ and in order to stress this, it may be written X_λ (λ) without any change of meaning

[SOURCE: IEC 60050-845:1987, 845-01-16, modified – Note deleted.]

3.6
irradiance
quotient of the radiant flux $d\phi_e$ incident on an element of the surface containing the point, by the area dA of that element

Note 1 to entry: Irradiance is expressed in W/m^2.

[SOURCE: IEC 60050-845:1987, 845-01-37, modified – Domain and equivalent definition deleted.]

3.7
action spectrum
efficiency of monochromatic radiations for producing a specified phenomenon in a specified system

[SOURCE: IEC 60050-845:1987, 845-06-14, modified – Definition revised.]

3.8
effective
adjective that, when applied to a quantity pertaining to electromagnetic radiation, indicates that the quantity referred to is weighed according to a specified action spectrum

3.9
nominal value
approximate quantity value used to designate or identify a lamp

[SOURCE: IEC 60050-151:2001, 151-16-09, modified – Definition revised and note deleted.]

3.10
rated value
quantity value for a characteristic of a lamp for specified operating conditions

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

3.11
irradiance maintenance ratio
r
rated value of the ratio of the effective UV irradiance weighed according to the erythema action spectrum (250 nm to 400 nm) at a specified time to initial values

3.12
initial value
electrical and radiometric characteristics measured at the end of a 5 h ageing period

3.13
maintenance code
description of the depreciation of the UV irradiance lamp during operation between 5 h and 500 h

4 General test conditions

4.1 Ageing

Before the initial measurements, lamps shall be aged for a period of 5 h ± 0,25 h ~~under normal operating conditions~~.

The ageing shall be performed in accordance with Annex C.

4.2 Operating position

During ~~ageing and~~ measurement, lamps shall be operated in a horizontal position. Ageing is preferably in a horizontal position; a vertical position may also be applied.

Single capped lamps shall be positioned such that the sensor sees both legs of the lamp (see Figure 1). If the lamp has more than two limbs, the manufacturer or responsible vendor shall specify the measurement position.

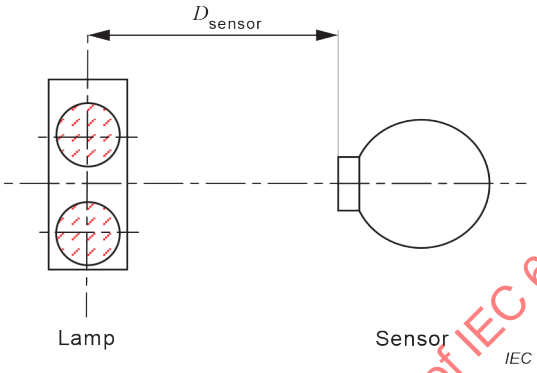


Figure 1 – Measurement position of single capped lamps

NOTE The lamp orientation in appliances used for skin exposure to ultraviolet radiation (sunbeds) can differ from the measuring position and hence the irradiance values can also differ.

4.3 Ambient temperature

The measurement shall be made in a draught-free atmosphere at an ambient temperature of 25 °C ± 1 °C.

~~NOTE~~ If applicable, lamps may also be measured under conditions different from the above standard ambient temperature conditions to establish the optimum UV irradiance, as described in Annex A.

4.4 Test voltage

All measurements shall be made by applying the test circuit in Figure 2 (preheat start).

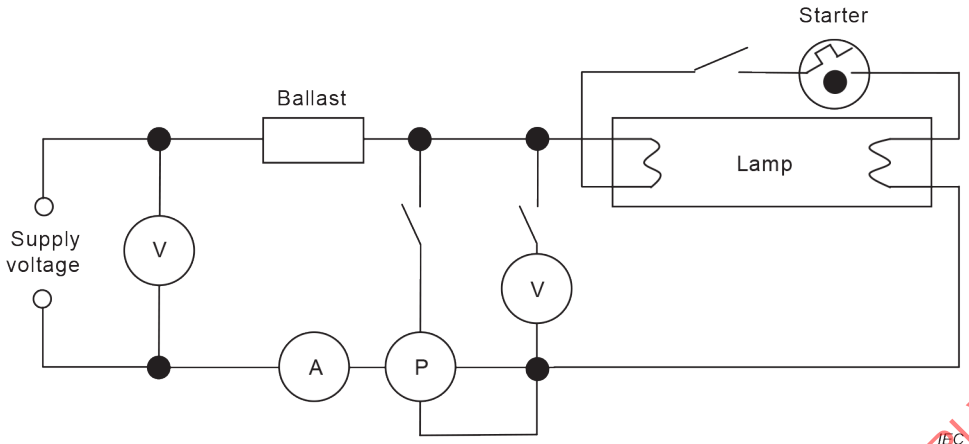


Figure 2 – Test circuit

The test voltage applied to the circuit shall be ~~as specified on the relevant lamp data sheet~~ 110 % of the rated voltage of the reference ballast with the starter circuit continuously closed.

The AC mains/supply voltage for the irradiance measurements shall maintain a tolerance of ±0,2 %.

The AC mains/supply frequency shall be 50 Hz ± 0,1 % or 60 Hz ± 0,1 % for each measurement.

4.5 Ballast

~~Lamps shall be operated with a reference ballast. In cases where a reference ballast has not been established, an appropriate test ballast shall be specified by the lamp manufacturer or responsible vendor.~~

~~The ballast shall be operating at a frequency of 50 – 60 Hz.~~

Lamps shall be operated with a ballast that generates electrical values for the operation of the respective lamp that match the values given by the corresponding lamp manufacturer or responsible vendor.

The ballast shall be operated at a frequency of 50 Hz or 60 Hz. The frequency shall be specified for each measurement.

5 Test requirements

5.1 General

Spectroradiometric measurements shall be made in accordance with the relevant recommendations of the CIE (International commission on illumination), as given in CIE 63.

NOTE 1 Additional information about UV measurements is given in Annex B of IEC 62471:2006.

NOTE 2 Additional requirements for electrical measurements are given in Annex B of IEC 60081:1997, Annex B of IEC 60081:1997/AMD2:2003, Annex B of IEC 60081:1997/AMD4:2010, Annex B of IEC 60081:1997/AMD5:2013 and Annex B of IEC 60901:1996, Annex B of IEC 60901:1996/AMD2:2000, Annex B of IEC 60901:1996/AMD5:2011 and Annex B of IEC 60901:1996/AMD6:2014.

5.2 Spectroradiometric measuring system

Lamps shall be measured in ~~an appropriate spectroradiometric~~ a spectroradiometer system to obtain the spectral irradiance.

The system input optics shall have a cosine response to accurately measure irradiance.

The spectroradiometer shall have a bandwidth at a given wavelength not exceeding 2,5 nm and its wavelength resolution shall not be higher than 1 nm.

~~The distance between detector and lamp axis is not specified but shall be not less than 10 cm.~~

~~NOTE 1 For the publication of the final lamp specifications, the measured irradiance values are corrected to arrive at irradiance values at 25 cm distance from the lamp axis (see 6.3).~~

~~NOTE 2 A bandwidth of 1 nm is advisable for greater measurement accuracy in cases where a rapid change of the spectral irradiance occurs within a small bandwidth area.~~

~~NOTE 3 The bandwidth should be at least 2,5 times the measurement interval.(e.g. 2,5 nm bandwidth requires 1 nm measurement interval)~~

The distance between sensor and lamp axis, D_{sensor}, shall be (25 ± 0,5) cm (see Figure 1).

NOTE A bandwidth at a given wavelength of 1 nm is preferred for greater measurement accuracy in cases where a rapid change of the spectral irradiance occurs within a small bandwidth area.

6 Measurement and evaluation procedure

6.1 Measurement

6.1.1 General

The spectral irradiance shall be measured at intervals of 1 nm from 250 nm to 400 nm. Under the test conditions, the lamp power, current and voltage shall be recorded. The lamp shall be in stable electric and radiometric conditions.

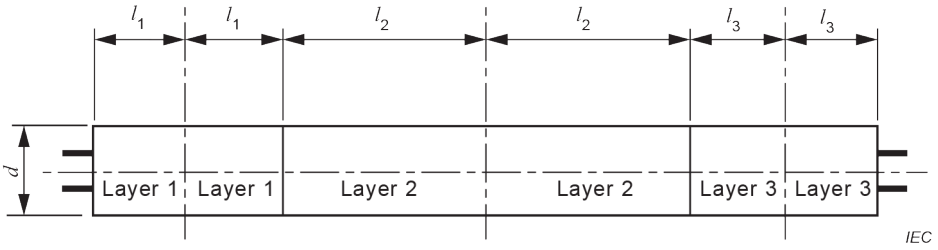
6.1.2 Double capped fluorescent UV Lamps

Double capped UV fluorescent lamps shall be operated during measurement such that the lamp axis is at the same height as the centre of the entrance aperture of the sensor. The sensor shall be placed in front of the middle of the lamp (see Figure 1).

Reflector lamps shall be operated such that the non-reflecting side is directed towards the entrance aperture of the spectroradiometer. Lamps having a portion with no phosphor layer shall be positioned such that the uncoated portion is directed centrally towards the entrance aperture of the spectroradiometer.

UV Lamps having more than one phosphor layer along the lamp axis (see Figure 3) shall be measured in front of the middle of that layer, which shows the highest erythema effective irradiance.

NOTE For determining the layer showing the highest erythema effective irradiance, a spectral broad band radiometer can be used.



The drawing shows three layers.

Figure 3 – Location of measurement points on lamps with more than one layer

6.1.3 Single capped fluorescent UV Lamps

Single capped UV fluorescent lamps shall be operated during measurement such that the middle of the lamp bulb is at the same height as the centre of the entrance aperture of the sensor.

Single capped UV fluorescent lamps shall be operated during measurement such that both limbs have the same distance to the centre of the entrance aperture of the spectroradiometer (see 4.2 and Figure 1).

For single capped fluorescent UV lamps having more than two limbs, the measurement position that results in the highest measured erythema effective irradiance shall be specified by the manufacturer or responsible vendor.

6.2 Calculation of the total effective UV irradiance

The total effective UV irradiance shall be calculated from the spectral irradiance using the following formula:

$$E_{\text{eff}} = \Sigma\, E_\lambda \cdot S(\lambda) \cdot \Delta\lambda$$

where

E_{eff} is the total effective irradiance (W/m^2);

E_λ is the spectral irradiance (W/(m^2 · nm));

$S(\lambda)$ is the weighting factor according to the applicable action spectrum;

$\Delta\lambda$ is the wavelength interval (nm).

The wavelength interval for the calculation shall ~~preferably~~ be ~~equal to the bandwidth~~ 1 nm.

The applicable action spectra for erythema and non-melanoma skin cancer (NMSC) are given in Annex B.

For the total effective UV irradiance weighted according to the erythema action spectrum, the summation shall be performed over the following wavelength range: 250 nm ≤ λ ≤ 400 nm.

For the total effective UV irradiance weighted according to the NMSC action spectrum, the summation shall be performed over two wavelength ranges: 250 nm ≤ λ ≤ 320 nm, and 320 nm ~~<~~ ≤ λ ≤ 400 nm. The separate sums will be used in the specification of the equivalency code in Clause 8.

NOTE 1 The limit of 320 nm is chosen in accordance with IEC 60335-2-27, where, for this application, the CIE nomenclature UV-A and UV-B with a limit of 315 nm is not used.

NOTE 2 For evaluating the border wavelength of each wavelength interval accurate for calculating the total effective irradiance values, the trapezoid formula is used:

$$E_{\text{eff}} = 0{,}5 \cdot E_{\lambda}\left(\lambda = \lambda_{\text{u}}\right) \cdot S\left(\lambda = \lambda_{\text{u}}\right) + \sum_{\lambda_{\text{u}+1}}^{\lambda_{\text{o}-1}} E_{\lambda}\left(\lambda\right) \cdot S\left(\lambda\right) \cdot \Delta\lambda + 0{,}5 \cdot E_{\lambda}\left(\lambda = \lambda_{\text{o}}\right) \cdot S\left(\lambda = \lambda_{\text{o}}\right)$$

where

λ_{u} is the lower border wavelength of the wavelength interval;

λ_{o} is the upper border wavelength of the wavelength interval.

6.3 ~~Correction factors~~ Ambient temperature adjustment

In order to arrive at the final total effective UV irradiance values, the following ~~two~~ correction factor~~s~~ may have to be applied:

~~a) for lamps having the optimum UV irradiance at an ambient temperature other than 25 °C, a factor to obtain the optimum UV irradiance, as described in Annex A;~~

~~b) for lamps measured at a distance other than 25 cm, a factor to obtain the UV irradiance at 25 cm distance. This geometrical factor can be obtained for each lamp type either experimentally or by calculation.~~

For lamps having the optimum UV irradiance at an ambient temperature other than 25 °C, a factor shall be applied to obtain the optimum UV irradiance, as specified in Annex A.

6.4 Reflector angle

The reflector angle of fluorescent UV lamps shall be measured by using a reflector angle gauge, in accordance with Annex D. The measurement of the reflector angle shall be performed in the middle of the lamp.

If the lamp to be measured is not covered by the gauge shown in Annex D (see Figure D.1), the measurement of the reflector angle shall be specified by the manufacturer or the responsible vendor.

6.5 Determination of the lamp maintenance code

Lamps shall be designated by a maintenance code in accordance with the ratio, r, of UV radiance measured at 500 h divided by the UV radiance measured at 5 h.

For expression in the equivalency code IR, (see Clause 8), the UV irradiance ratio, r, shall be multiplied by ten and the result rounded down to the next integer value.

7 Lamp specification

The following information shall be given for each lamp type in the ~~manufacturers literature~~ manufacturer's documentation:

a) lamp dimensions;

b) for reflector lamps, the reflector angle α, i.e. the angle subtended at the lamp axis by the reflector coating;

c) the ~~type of~~ ballast (operation frequency, nominal wattage) for which the lamp is designed;

NOTE Operation frequency can either be 50 Hz/60 Hz and/or HF.

d) the rated electrical characteristics:

– lamp wattage;

- lamp current;
- lamp voltage;

e) ~~three~~ the rated total effective UV irradiance values at a (25 ± 0,5) cm distance from the lamp axis and weighted in accordance with Annex B:
   - the erythema action spectrum over the wavelength range 250 nm ≤ λ ≤ 400 nm;
   - the NMSC action spectrum over the wavelength range 250 nm ≤ λ ≤ 320 nm;
   - the NMSC action spectrum over the wavelength range 320 nm ~~<~~ ≤ λ ≤ 400 nm.

f) the equivalency code (see Clause 8);

The values under items d) and e) shall be given under conditions of optimum UV irradiance.

The values under item e) shall be given in mW/m^2 and rounded to the nearest integer.

8 Lamp marking

The following information shall be legibly and durably marked on the lamp:

a) the type reference of the lamp, containing:
   - a mark of origin (this may take the form of a trademark, the manufacturer's name or the name of the responsible vendor);
   - the nominal lamp wattage (marked "W" or "watts");
   - a further identification of the specific lamp type (mostly in the form of a commercial designation);

b) the equivalency code, in the form: Wattage–Reflector type code–UV code–Maintenance code: The maintenance code IR (see 6.5) shall be used in the equivalency code only for lamps intended for operation with dimmable ballasts.
   - The wattage in the equivalency code shall be the nominal lamp wattage.
   - The following reflector type code shall be used in the equivalency code:
     - O for non-reflector lamps;
     - B for lamps with a broad reflector angle α > 230°;
     - N for lamps with a narrow reflector angle α < 200°;
     - R for lamps with a regular reflector 200° ≤ α ≤ 230°.
   - The following UV code shall be used in the equivalency code:

     UV code = X/Y

     X = total erythema effective UV irradiance over the range 250 nm to 400 nm;

     Y = ratio of the NMSC effective UV irradiances ≤ 320 nm and ~~></~~ ≥ 320 nm.

     X is to be given in mW/m^2 rounded to the nearest integer, Y is to be rounded to the nearest first decimal. The effective values are at a 25 cm distance and under conditions of optimum UV irradiance.
   - The maintenance code IR (see 6.5) shall be used in the equivalency code:

EXAMPLE

100 W reflector lamp with 220° reflector angle

Erythema effective UV irradiance (250 nm to 400 nm) = 47 mW/m^2

Short wave NMSC effective UV irradiance (≤ 320 nm) = 61 mW/m^2

Long wave NMSC effective UV irradiance (~~></~~ ≥ 320 nm) = 19 mW/m^2

Irradiance maintenance ratio r = 0,83 (83 %)

Equivalency code: 100–R–47/3,2/8

Annex A
(normative)

Determination of the optimum UV irradiance of fluorescent UV lamps

Many fluorescent UV lamps for tanning have a very high wall loading. When operated at the standard ambient temperature of 25 °C, the vapour pressure will be too high, and the emitted UV radiation will be lower than its optimum value. In many appliances, forced cooling is applied in order to reach optimum conditions for the radiation. The electrical characteristics and the effective UV irradiance have to be specified under these conditions for optimum UV irradiance.

To arrive at the values at optimum UV irradiance ~~two methods can~~, the following method shall be applied:

~~a) the measurement is made under non-standard ambient conditions to control the vapour pressure, i.e. by a lower ambient temperature or by local cooling. The conditions to be applied are dependent on the lamp type and shall be described in the manufacturer's documentation.~~

~~b) the measurement is made under standard ambient conditions and a correction factor is applied to the results. This correction factor can be determined for each lamp type from a continuous plot of the UV irradiance, emitted by the phosphor, during the run-up of the lamp until a stable situation is reached. From this plot, the maximum value and the value after stabilisation can be measured. The correction factor to be applied follows from the quotient of the maximum value by the stabilised value. At the time of maximum UV irradiance the lamp wattage, current and voltage have to be recorded.~~

~~In case of dispute, the second method shall be the reference measuring method.~~

Start and operate a lamp through a complete warm-up and using a fast detector, record an erythema effective irradiance plot every second. Determine the maximum erythema effective irradiance over the range 250 nm to 400 nm during the warm-up phase. Cool the lamp to stabilized conditions at the maximum erythema effective irradiance and perform spectral measurements with a double monochromator. Determine the values of X, the total erythema effective UV irradiance over the range 250 nm to 400 nm and Y, the ratio of the NMSC effective UV irradiances ≤ 320 nm and ≥ 320 nm from this spectral measurement.

Annex B
(normative)

Ultraviolet action spectra

The UV action spectra to be applied ~~are~~ shall be the erythema and the non-melanoma skin cancer (NMSC) action spectra, as given in IEC 60335-2-27 and in ISO/CIE 28077:2016.

The action spectra are shown graphically in Figure B.1 and the weighting factors $S(\lambda)$ are listed in Table B.1.

NOTE The erythema action spectrum is defined from the following parameters:

Wavelength λ (nm)	**Weighting factor $S(\lambda)$**
$\lambda \leq 298$	1
$298 < \lambda \leq 328$	$10^{0,094(298 - \lambda)}$
$328 < \lambda \leq 400$	$10^{0,015(140 - \lambda)}$

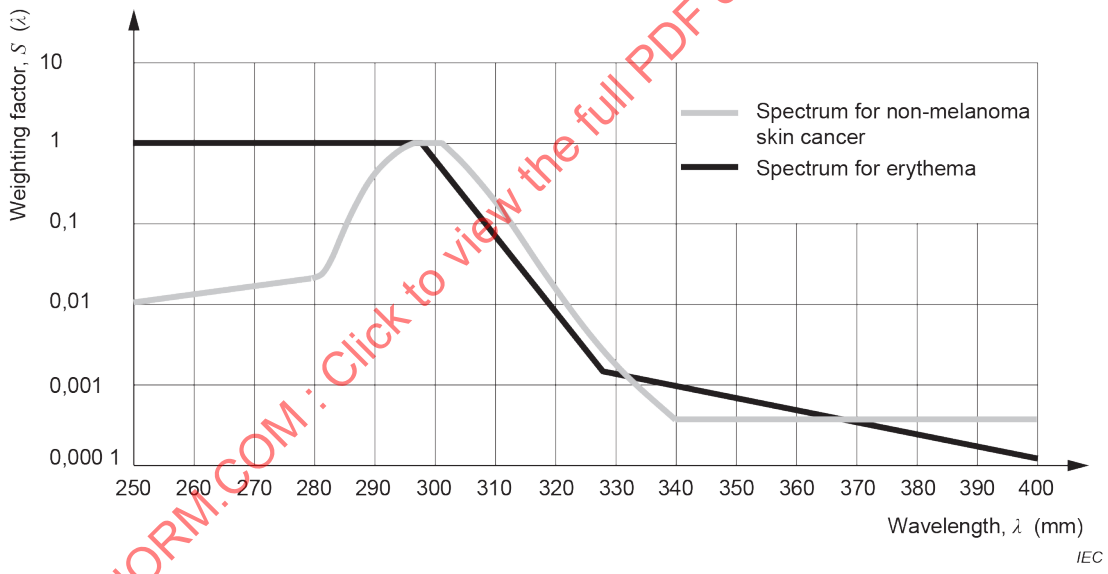


Figure B.1 – UV action spectra for erythema and NMSC

Table B.1 – Weighting factors $S(\lambda)$ for erythema and NMSC action spectrum

Wavelength nm	Weighting factor	
	Erythema	NMSC
250	1,000 000	0,010 900
251	1,000 000	0,011 139
252	1,000 000	0,011 383
253	1,000 000	0,011 633
254	1,000 000	0,011 888
255	1,000 000	0,012 158
256	1,000 000	0,012 435
257	1,000 000	0,012 718
258	1,000 000	0,013 007
259	1,000 000	0,013 303
260	1,000 000	0,013 605
261	1,000 000	0,013 915
262	1,000 000	0,014 231
263	1,000 000	0,014 555
264	1,000 000	0,014 886
265	1,000 000	0,015 225
266	1,000 000	0,015 571
267	1,000 000	0,015 925
268	1,000 000	0,016 287
269	1,000 000	0,016 658
270	1,000 000	0,017 037
271	1,000 000	0,017 424
272	1,000 000	0,017 821
273	1,000 000	0,018 226
274	1,000 000	0,018 641
275	1,000 000	0,019 065
276	1,000 000	0,019 498
277	1,000 000	0,019 942
278	1,000 000	0,020 395
279	1,000 000	0,020 859
280	1,000 000	0,021 334
281	1,000 000	0,025 368
282	1,000 000	0,030 166
283	1,000 000	0,035 871
284	1,000 000	0,057 388
285	1,000 000	0,088 044
286	1,000 000	0,129 670
287	1,000 000	0,183 618
288	1,000 000	0,250 586
289	1,000 000	0,330 048
290	1,000 000	0,420 338
291	1,000 000	0,514 138
292	1,000 000	0,609 954
293	1,000 000	0,703 140
294	1,000 000	0,788 659
295	1,000000	0,861 948
296	1,000 000	0,919 650
297	1,000 000	0,958 965
298	1,000 000	0,988 917
299	0,805 378	1,000 000

Wavelength nm	Weighting factor	
	Erythema	NMSC
300	0,648 634	0,991 996
301	0,522 396	0,967 660
302	0,420 727	0,929 095
303	0,338 844	0,798 410
304	0,272 898	0,677 339
305	0,219 786	0,567 466
306	0,177 011	0,470 257
307	0,142 561	0,385 911
308	0,114 815	0,313 889
309	0,092 469	0,253 391
310	0,074 473	0,203 182
311	0,059 979	0,162 032
312	0,048 306	0,128 671
313	0,038 905	0,101 794
314	0,031 333	0,079 247
315	0,025 235	0,061 659
316	0,020 324	0,047 902
317	0,016 368	0,037 223
318	0,013 183	0,028 934
319	0,010 617	0,022 529
320	0,008 551	0,017 584
321	0,006 887	0,013 758
322	0,005 546	0,010 804
323	0,004 467	0,008 525
324	0,003 597	0,006 756
325	0,002 897	0,005 385
326	0,002 333	0,004 316
327	0,001 879	0,003 483
328	0,001 514	0,002 830
329	0,001 462	0,002 316
330	0,001 413	0,001 911
331	0,001 365	0,001 590
332	0,001 318	0,001 333
333	0,001 274	0,001 129
334	0,001 230	0,000 964
335	0,001 189	0,000 810
336	0,001 148	0,000 688
337	0,001 109	0,000 589
338	0,001 072	0,000 510
339	0,001 035	0,000 446
340	0,001 000	0,000 394
341	0,000 966	0,000 394
342	0,000 933	0,000 394
343	0,000 902	0,000 394
344	0,000 871	0,000 394
345	0,000 841	0,000 394
346	0,000 813	0,000 394
347	0,000 785	0,000 394
348	0,000 759	0,000 394
349	0,000 733	0,000 394

Wavelength nm	Weighting factor	
	Erythema	NMSC
350	0,000 708	0,000 394
351	0,000 684	0,000 394
352	0,000 661	0,000 394
353	0,000 638	0,000 394
354	0,000 617	0,000 394
355	0,000 596	0,000 394
356	0,000 575	0,000 394
357	0,000 556	0,000 394
358	0,000 537	0,000 394
359	0,000 519	0,000 394
360	0,000 501	0,000 394
361	0,000 484	0,000 394
362	0,000 468	0,000 394
363	0,000 452	0,000 394
364	0,000 437	0,000 394
365	0,000 422	0,000 394
366	0,000 407	0,000 394
367	0,000 394	0,000 394
368	0,000 380	0,000 394
369	0,000 367	0,000 394
370	0,000 355	0,000 394
371	0,000 343	0,000 394
372	0,000 331	0,000 394
373	0,000 320	0,000 394
374	0,000 309	0,000 394
375	0,000 299	0,000 394
376	0,000 288	0,000 394
377	0,000 279	0,000 394
378	0,000 269	0,000 394
379	0,000 260	0,000 394
380	0,000 251	0,000 394
381	0,000 243	0,000 394
382	0,000 234	0,000 394
383	0,000 226	0,000 394
384	0,000 219	0,000 394
385	0,000 211	0,000 394
386	0,000 204	0,000 394
387	0,000 197	0,000 394
388	0,000 191	0,000 394
389	0,000 184	0,000 394
390	0,000 178	0,000 394
391	0,000 172	0,000 394
392	0,000 166	0,000 394
393	0,000 160	0,000 394
394	0,000 155	0,000 394
395	0,000 150	0,000 394
396	0,000 145	0,000 394
397	0,000 140	0,000 394
398	0,000 135	0,000 394
399	0,000 130	0,000 394
400	0,000 126	0,000 394

Annex C
(normative)

Method of test for irradiance maintenance

C.1 General

The irradiance at a given time in the life of a lamp shall be measured as specified in Clauses 4, 5 and 6.

During ageing, lamps shall be operated as follows:

- Lamps should preferably be operated at an ambient temperature between 15 °C and 50 °C. Excessive draughts shall be avoided, and the lamps shall not be subjected to extreme vibration and shock.
- Lamps shall be operated in a horizontal position; a vertical position may also be applied.
- The connections of the lamp contacts, with reference to the terminations of the ballast, shall not be changed for the whole course of the tests.
- Lamps shall be operated in the circuit for which they are intended by the manufacturer.
- Lamps shall be switched for ageing. The switching cycle shall be specified by the manufacturer. The OFF-time interval shall not be less than 2 min.

NOTE Typical switching cycles are 25 min ON/5 min OFF or 20 min ON/5 min OFF or 10 min ON/2 min OFF.

C.2 Lamps for operation on AC mains frequencies

Ballasts used to operate lamps at AC mains frequency shall comply with the requirements of IEC 60921. Additionally, for capacitive circuits, the capacitor used shall comply with the requirements of IEC 61049.

The choice of the type of ballasts for these tests is left open, but the type used can have an influence on the results of the test. It is recommended that the type of ballast employed should be stated. In case of doubt, the use of an inductive type of ballast is recommended because such a type has the smallest number of parameters capable of affecting the results.

For lamps operated with a starter, the preheating current, at rated supply voltage, shall not differ by more than 10 % from the rated value specified by the corresponding manufacturer or responsible vendor.

For lamps operated with a starter, the type of starter to be used shall comply with the requirements of IEC 60155, and shall in any case be subject to agreement with the lamp manufacturer or responsible vendor.

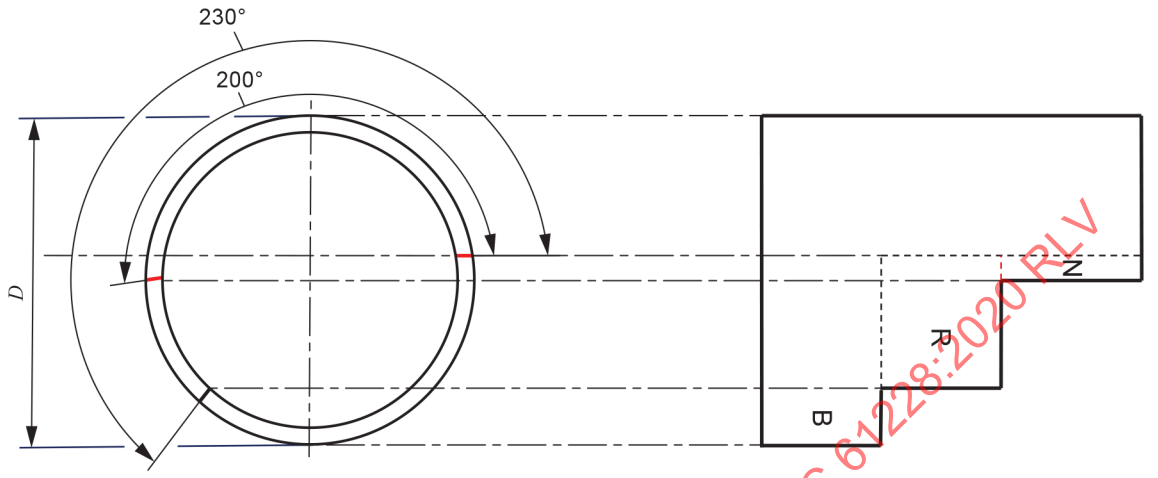
During ageing, the supply voltage and frequency shall not differ by more than 2 % from the rated voltage and frequency of the ballast used.

C.3 Lamps for operation on high frequency

Ballasts used to operate lamps on frequencies above the AC mains frequency shall comply with the requirements of IEC 60929.

Annex D
(normative)

Reflector gauge



Measure	T5 [mm]	T8 [mm]	T12 [mm]	Diameter
D	17	29	41,5	Min.

NOTE Dimensions N, R and B are specified in Clause 8, item b)

Figure D.1 – Reflector gauge

Annex E
(normative)

Lamp datasheets for measurement

The AC mains/supply voltage for the irradiance measurements shall maintain a tolerance of ±0,2 %. The AC mains/supply frequency shall be 50 Hz with a tolerance of ±0,1 % or 60 Hz with a tolerance of ±0,1 %. The AC mains/supply frequency shall be specified for each measurement.

The dimensional provisions A, B, C, D in Table E.1 shall comply with sheet 60081-IEC-01-1 of IEC 60081:1997. Lamps listed in Table E.1 shall comply with the cap dimensions specified in IEC 60061-1. Similarly, the lamp dimensions for the listed lamps in IEC 60061-1 shall comply with the values indicated in Table E.1.

Table E.1 – Lamp dimensions

Lamp type	Nominal power W	Lamp cap[a]	Nominal dimensions mm	A_{max} mm	B_{min} mm	B_{max} mm	C_{max} mm	D_{max}[b] mm
T5 linear fluorescent								
0,300m F12 T5 15W	15	G5	300 x 16	288,3	293,0	295,4	302,5	16,0
0,525m F21 T5 25W	25	G5	525 x 16	516,9	521,6	524,0	531,1	16,0
T12 linear fluorescent								
1,76m F71 T12 100W	100	G13	1 760 x 38	1 763,8	1 768,5	1 770,9	1 778,0	40,5
1,90m F75 T12 120W	120	G13	1 900 x 38	1 901,3	1 905,8	1 908,4	1 915,5	40,5
2,00m F79 T12 120W	120	G13	2 000 x 38	2 001,3	2 005,8	2 008,4	2 015,5	40,5
1,50m F59 T12 140W sm	140	G13	1 500 x 38	1 500,0	1 504,7	1 507,1	1 514,2	40,5
1,50m F59 T12 140W lm	140	G13	1 500 x 38	1 500,0	1 504,7	1 507,1	1 514,2	40,5
1,76m F71 T12 160W sm	160	G13	1 760 x 38	1 763,8	1 768,5	1 770,9	1 778,0	40,5
1,76m F71 T12 160W lm	160	G13	1 760 x 38	1 763,8	1 768,5	1 770,9	1 778,0	40,5
1,90m F75 T12 160W sm	160	G13	1 900 x 38	1 901,3	1 905,8	1 908,4	1 915,5	40,5
1,90m F75 T12 180W sm	180	G13	1 900 x 38	1 901,3	1 905,8	1 908,4	1 915,5	40,5
2,00m F79 T12 180W sm	180	G13	2 000 x 38	2 001,3	2 005,8	2 008,4	2 015,5	40,5
2,00m F79 T12 180W lm	180	G13	2 000 x 38	2 001,3	2 005,8	2 008,4	2 015,5	40,5
2,00m F79 T12 225W lm	225	G13	2 000 x 38	2 001,3	2 005,8	2 008,4	2 015,5	40,5

[a] In accordance with IEC 60061-1.

[b] In accordance with IEC 60081.

Bibliography

IEC 60050-151, *International Electrotechnical Vocabulary (IEV) – Part 151: Electrical and magnetic devices* (available at http://www.electropedia.org)

IEC 60050-845, *International Electrotechnical Vocabulary (IEV) – Part 845: Lighting* (available at http://www.electropedia.org)

IEC 60081:1997, *Double-capped fluorescent lamps – Performance specifications*
IEC 60081:1997/AMD1:2000
IEC 60081:1997/AMD2:2003
IEC 60081:1997/AMD3:2005
IEC 60081:1997/AMD4:2010
IEC 60081:1997/AMD5:2013
IEC 60081:1997/AMD6:2017

IEC 60901:1996, *Single-capped fluorescent lamps – Performance specifications*
IEC 60901:1996/AMD1:1997
IEC 60901:1996/AMD2:2000
IEC 60901:1996/AMD3:2004
IEC 60901:1996/AMD4:2007
IEC 60901:1996/AMD5:2011
IEC 60901:1996/AMD6:2014

IEC 61195, *Double-capped fluorescent lamps – Safety specifications*

IEC 61199, *Single-capped fluorescent lamps – Safety specifications*

IEC 62471:2006, *Photobiological safety of lamps and lamp systems*

EN 13032-1:2012-06, *Light and lighting – Measurement and presentation of photometric data of lamps and luminaires – Part 1: Measurement and file format*

IEC 61228

Edition 3.0 2020-11

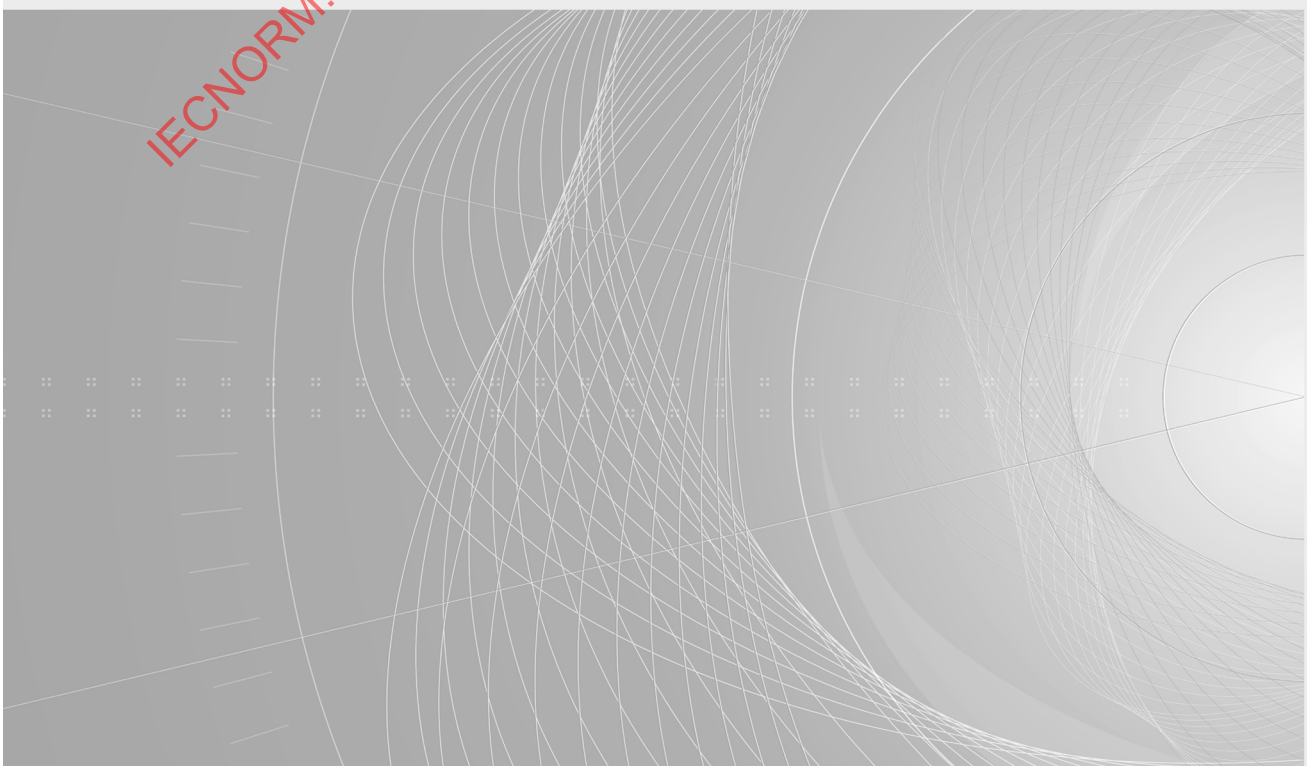
INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Fluorescent ultraviolet lamps used for tanning – Measurement and specification method

Lampes fluorescentes à ultraviolet utilisées pour le bronzage – Méthode de mesure et de spécification



IEC 61228:2020-11(en-fr)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FLUORESCENT ULTRAVIOLET LAMPS USED FOR TANNING – MEASUREMENT AND SPECIFICATION METHOD

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61228 has been prepared by subcommittee 34A: Electric light sources, of IEC technical committee 34: Lighting.

This third edition cancels and replaces the second edition published in 2008. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) maintenance code: description of the depreciation of the UV irradiance lamp during operation;
b) operating position: information added for single capped lamps;
c) spectroradiometric measuring system: new information about distance between sensor and lamp axis;
d) measurement and evaluation procedure: separated detailed information for double capped fluorescent UV lamps and single capped fluorescent UV lamps;
e) Annex C (normative), Method of test for irradiance maintenance: new information added;
f) Annex D (normative), Reflector gauge: new information added;

g) Annex E (normative), Lamp datasheets for measurement: complementary information added.

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

FDIS	Report on voting
34A/2213/FDIS	34A/2220/RVD

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.

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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

FLUORESCENT ULTRAVIOLET LAMPS USED FOR TANNING – MEASUREMENT AND SPECIFICATION METHOD

1 Scope

This document describes the method of measuring, evaluating and specifying the UV irradiation characteristics of fluorescent ultraviolet lamps that are used in appliances for tanning purposes. It includes specific requirements regarding the marking of such lamps.

These requirements relate only to type testing.

Lamps complying with the requirements of this document comply with the electrical and mechanical safety requirements of IEC 61195 and IEC 61199 with the exception of the requirements for maximum limits of UV radiation.

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 60061-1, *Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 1: Lamp caps*

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

IEC 60155, *Glow-starters for fluorescent lamps*

IEC 60335-2-27, *Household and similar electrical appliances – Safety – Part 2-27: Particular requirements for appliances for skin exposure to optical radiation*

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

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

IEC 61049, *Capacitors for use in tubular fluorescent and other discharge lamp circuits. Performance requirements*

ISO/CIE 28077:2016, *Photocarcinogenesis action spectrum (non-melanoma skin cancers)*

CIE 63:1984, *The spectroradiometric measurement of light sources*

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
ultraviolet lamp
lamp which radiates especially strongly in the ultraviolet, the visible radiation produced, if any, not being of direct interest

[SOURCE: IEC 60050-845:1987, 845-07-52, modified – Note deleted.]

3.2
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 ultraviolet radiation from the discharge

[SOURCE: IEC 60050-845:1987, 845-07-26, modified – Note deleted.]

3.3
spectroradiometer
instrument for measuring radiometric quantities in narrow wavelength intervals over a given spectral region

[SOURCE: IEC 60050-845:1987, 845-05-07]

3.4
bandwidth at a given wavelength
width at half-amplitude points of the transmittance function of a monochromator

Note 1 to entry: The bandwidth is expressed in nm.

3.5
spectral
adjective that, when applied to a quantity X pertaining to electromagnetic radiation, indicates:

– either that X is a function of the wavelength λ, symbol: $X(\lambda)$;
– or that the quantity referred to is the spectral concentration of X, symbol: $X_\lambda = \mathrm{d}X/\mathrm{d}\lambda$.

X_λ is also a function of λ and in order to stress this, it may be written X_λ (λ) without any change of meaning.

[SOURCE: IEC 60050-845:1987, 845-01-16, modified – Note deleted.]

3.6
irradiance
quotient of the radiant flux $\mathrm{d}\phi_e$ incident on an element of the surface containing the point, by the area $\mathrm{d}A$ of that element

Note 1 to entry: Irradiance is expressed in W/m^2.

[SOURCE: IEC 60050-845:1987, 845-01-37, modified – Domain and equivalent definition deleted.]

3.7
action spectrum
efficiency of monochromatic radiations for producing a specified phenomenon in a specified system

[SOURCE: IEC 60050-845:1987, 845-06-14, modified – Definition revised.]

3.8
effective
adjective that, when applied to a quantity pertaining to electromagnetic radiation, indicates that the quantity referred to is weighed according to a specified action spectrum

3.9
nominal value
approximate quantity value used to designate or identify a lamp

[SOURCE: IEC 60050-151:2001, 151-16-09, modified – Definition revised and note deleted.]

3.10
rated value
quantity value for a characteristic of a lamp for specified operating conditions

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

3.11
irradiance maintenance ratio
r
rated value of the ratio of the effective UV irradiance weighed according to the erythema action spectrum (250 nm to 400 nm) at a specified time to initial values

3.12
initial value
electrical and radiometric characteristics measured at the end of a 5 h ageing period

3.13
maintenance code
description of the depreciation of the UV irradiance lamp during operation between 5 h and 500 h

4 General test conditions

4.1 Ageing

Before the initial measurements, lamps shall be aged for a period of 5 h ± 0,25 h.

The ageing shall be performed in accordance with Annex C.

4.2 Operating position

During measurement, lamps shall be operated in a horizontal position. Ageing is preferably in a horizontal position; a vertical position may also be applied.

Single capped lamps shall be positioned such that the sensor sees both legs of the lamp (see Figure 1). If the lamp has more than two limbs, the manufacturer or responsible vendor shall specify the measurement position.

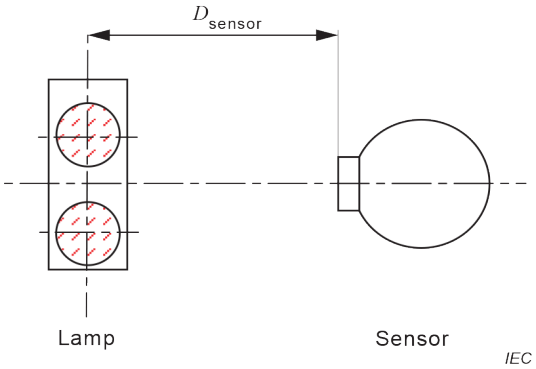


Figure 1 – Measurement position of single capped lamps

NOTE The lamp orientation in appliances used for skin exposure to ultraviolet radiation (sunbeds) can differ from the measuring position and hence the irradiance values can also differ.

4.3 Ambient temperature

The measurement shall be made in a draught-free atmosphere at an ambient temperature of 25 °C ± 1 °C.

If applicable, lamps may also be measured under conditions different from the above standard ambient temperature conditions to establish the optimum UV irradiance, as described in Annex A.

4.4 Test voltage

All measurements shall be made by applying the test circuit in Figure 2 (preheat start).

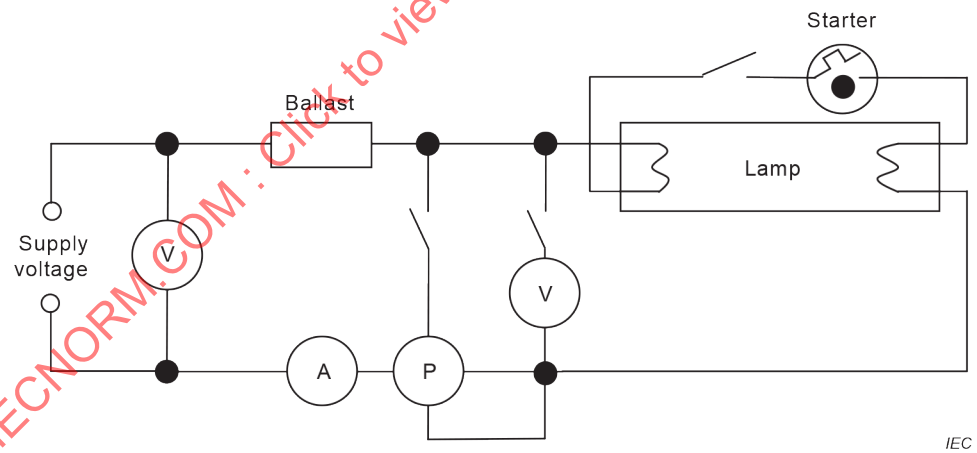


Figure 2 – Test circuit

The test voltage applied to the circuit shall be 110 % of the rated voltage of the reference ballast with the starter circuit continuously closed.

The AC mains/supply voltage for the irradiance measurements shall maintain a tolerance of ±0,2 %.

The AC mains/supply frequency shall be 50 Hz ± 0,1 % or 60 Hz ± 0,1 % for each measurement.

4.5 Ballast

Lamps shall be operated with a ballast that generates electrical values for the operation of the respective lamp that match the values given by the corresponding lamp manufacturer or responsible vendor.

The ballast shall be operated at a frequency of 50 Hz or 60 Hz. The frequency shall be specified for each measurement.

5 Test requirements

5.1 General

Spectroradiometric measurements shall be made in accordance with the relevant recommendations of the CIE (International commission on illumination), as given in CIE 63.

NOTE 1 Additional information about UV measurements is given in Annex B of IEC 62471:2006.

NOTE 2 Additional requirements for electrical measurements are given in Annex B of IEC 60081:1997, Annex B of IEC 60081:1997/AMD2:2003, Annex B of IEC 60081:1997/AMD4:2010, Annex B of IEC 60081:1997/AMD5:2013 and Annex B of IEC 60901:1996, Annex B of IEC 60901:1996/AMD2:2000, Annex B of IEC 60901:1996/AMD5:2011 and Annex B of IEC 60901:1996/AMD6:2014.

5.2 Spectroradiometric measuring system

Lamps shall be measured in a spectroradiometer system to obtain the spectral irradiance.

The system input optics shall have a cosine response to accurately measure irradiance.

The spectroradiometer shall have a bandwidth at a given wavelength not exceeding 2,5 nm and its wavelength resolution shall not be higher than 1 nm.

The distance between sensor and lamp axis, D_{sensor}, shall be (25 ± 0,5) cm (see Figure 1).

NOTE A bandwidth at a given wavelength of 1 nm is preferred for greater measurement accuracy in cases where a rapid change of the spectral irradiance occurs within a small bandwidth area.

6 Measurement and evaluation procedure

6.1 Measurement

6.1.1 General

The spectral irradiance shall be measured at intervals of 1 nm from 250 nm to 400 nm. Under the test conditions, the lamp power, current and voltage shall be recorded. The lamp shall be in stable electric and radiometric conditions.

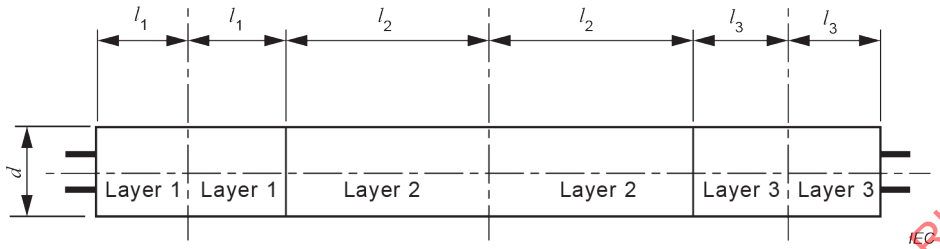
6.1.2 Double capped fluorescent UV Lamps

Double capped UV fluorescent lamps shall be operated during measurement such that the lamp axis is at the same height as the centre of the entrance aperture of the sensor. The sensor shall be placed in front of the middle of the lamp (see Figure 1).

Reflector lamps shall be operated such that the non-reflecting side is directed towards the entrance aperture of the spectroradiometer. Lamps having a portion with no phosphor layer shall be positioned, such that the uncoated portion is directed centrally towards the entrance aperture of the spectroradiometer.

UV Lamps having more than one phosphor layer along the lamp axis (see Figure 3) shall be measured in front of the middle of that layer, which shows the highest erythema effective irradiance.

NOTE For determining the layer showing the highest erythema effective irradiance, a spectral broad band radiometer can be used.



The drawing shows three layers.

Figure 3 – Location of measurement points on lamps with more than one layer

6.1.3 Single capped fluorescent UV Lamps

Single capped UV fluorescent lamps shall be operated during measurement such that the middle of the lamp bulb is at the same height as the centre of the entrance aperture of the sensor.

Single capped UV fluorescent lamps shall be operated during measurement such that both limbs have the same distance to the centre of the entrance aperture of the spectroradiometer (see 4.2 and Figure 1).

For single capped fluorescent UV lamps having more than two limbs, the measurement position that results in the highest measured erythema effective irradiance shall be specified by the manufacturer or responsible vendor.

6.2 Calculation of the total effective UV irradiance

The total effective UV irradiance shall be calculated from the spectral irradiance using the following formula:

$$E_{\text{eff}} = \Sigma\, E_\lambda \cdot S(\lambda) \cdot \Delta\lambda$$

where

E_{eff} is the total effective irradiance (W/m^2);

E_λ is the spectral irradiance (W/(m^2 · nm));

$S(\lambda)$ is the weighting factor according to the applicable action spectrum;

$\Delta\lambda$ is the wavelength interval (nm).

The wavelength interval for the calculation shall be 1 nm.

The applicable action spectra for erythema and non-melanoma skin cancer (NMSC) are given in Annex B.

For the total effective UV irradiance weighted according to the erythema action spectrum, the summation shall be performed over the following wavelength range: 250 nm ≤ λ ≤ 400 nm.

For the total effective UV irradiance weighted according to the NMSC action spectrum, the summation shall be performed over two wavelength ranges: 250 nm ≤ λ ≤ 320 nm, and 320 nm ≤ λ ≤ 400 nm. The separate sums will be used in the specification of the equivalency code in Clause 8.

NOTE 1 The limit of 320 nm is chosen in accordance with IEC 60335-2-27, where, for this application, the CIE nomenclature UV-A and UV-B with a limit of 315 nm is not used.

NOTE 2 For evaluating the border wavelength of each wavelength interval accurate for calculating the total effective irradiance values, the trapezoid formula is used:

$$E_{\text{eff}} = 0{,}5 \cdot E_{\lambda}\left(\lambda = \lambda_{\text{u}}\right) \cdot S\left(\lambda = \lambda_{\text{u}}\right) + \sum_{\lambda_{\text{u+1}}}^{\lambda_{\text{o-1}}} E_{\lambda}\left(\lambda\right) \cdot S\left(\lambda\right) \cdot \Delta\lambda + 0{,}5 \cdot E_{\lambda}\left(\lambda = \lambda_{\text{o}}\right) \cdot S\left(\lambda = \lambda_{\text{o}}\right)$$

where

λ_{u} is the lower border wavelength of the wavelength interval;

λ_{o} is the upper border wavelength of the wavelength interval.

6.3 Ambient temperature adjustment

In order to arrive at the final total effective UV irradiance values, the following correction factor may have to be applied.

For lamps having the optimum UV irradiance at an ambient temperature other than 25 °C, a factor shall be applied to obtain the optimum UV irradiance, as specified in Annex A.

6.4 Reflector angle

The reflector angle of fluorescent UV lamps shall be measured by using a reflector angle gauge, in accordance with Annex D. The measurement of the reflector angle shall be performed in the middle of the lamp.

If the lamp to be measured is not covered by the gauge shown in Annex D (see Figure D.1), the measurement of the reflector angle shall be specified by the manufacturer or the responsible vendor.

6.5 Determination of the lamp maintenance code

Lamps shall be designated by a maintenance code in accordance with the ratio, r, of UV radiance measured at 500 h divided by the UV radiance measured at 5 h.

For expression in the equivalency code IR, (see Clause 8), the UV irradiance ratio, r, shall be multiplied by ten and the result rounded down to the next integer value.

7 Lamp specification

The following information shall be given for each lamp type in the manufacturer's documentation:

a) lamp dimensions;

b) for reflector lamps, the reflector angle α, i.e. the angle subtended at the lamp axis by the reflector coating;

c) the ballast (operation frequency, nominal wattage) for which the lamp is designed;

NOTE Operation frequency can either be 50 Hz/60 Hz and/or HF.

d) the rated electrical characteristics:

– lamp wattage;

- lamp current;
- lamp voltage;

e) the rated total effective UV irradiance values at a (25 ± 0,5) cm distance from the lamp axis and weighted in accordance with Annex B:
   - the erythema action spectrum over the wavelength range 250 nm ≤ λ ≤ 400 nm;
   - the NMSC action spectrum over the wavelength range 250 nm ≤ λ ≤ 320 nm;
   - the NMSC action spectrum over the wavelength range 320 nm ≤ λ ≤ 400 nm.

f) the equivalency code (see Clause 8);

The values under items d) and e) shall be given under conditions of optimum UV irradiance.

The values under item e) shall be given in mW/m^2 and rounded to the nearest integer.

8 Lamp marking

The following information shall be legibly and durably marked on the lamp:

a) the type reference of the lamp, containing:
   - a mark of origin (this may take the form of a trademark, the manufacturer's name or the name of the responsible vendor);
   - the nominal lamp wattage (marked "W" or "watts");
   - a further identification of the specific lamp type (mostly in the form of a commercial designation);

b) the equivalency code, in the form: Wattage–Reflector type code–UV code–Maintenance code: The maintenance code IR (see 6.5) shall be used in the equivalency code only for lamps intended for operation with dimmable ballasts.
   - The wattage in the equivalency code shall be the nominal lamp wattage.
   - The following reflector type code shall be used in the equivalency code:
     - O for non-reflector lamps;
     - B for lamps with a broad reflector angle α > 230°;
     - N for lamps with a narrow reflector angle α < 200°;
     - R for lamps with a regular reflector 200° ≤ α ≤ 230°.
   - The following UV code shall be used in the equivalency code:

     UV code = X/Y

     X = total erythema effective UV irradiance over the range 250 nm to 400 nm;

     Y = ratio of the NMSC effective UV irradiances ≤ 320 nm and ≥ 320 nm.

     X is to be given in mW/m^2 rounded to the nearest integer, Y is to be rounded to the nearest first decimal. The effective values are at a 25 cm distance and under conditions of optimum UV irradiance.
   - The maintenance code IR (see 6.5) shall be used in the equivalency code:

EXAMPLE

100 W reflector lamp with 220° reflector angle

Erythema effective UV irradiance (250 nm to 400 nm) = 47 mW/m^2

Short wave NMSC effective UV irradiance (≤ 320 nm) = 61 mW/m^2

Long wave NMSC effective UV irradiance (≥ 320 nm) = 19 mW/m^2

Irradiance maintenance ratio r = 0,83 (83 %)

Equivalency code: 100–R–47/3,2/8

Annex A
(normative)

Determination of the optimum UV irradiance of fluorescent UV lamps

Many fluorescent UV lamps for tanning have a very high wall loading. When operated at the standard ambient temperature of 25 °C, the vapour pressure will be too high, and the emitted UV radiation will be lower than its optimum value. In many appliances, forced cooling is applied in order to reach optimum conditions for the radiation. The electrical characteristics and the effective UV irradiance have to be specified under these conditions for optimum UV irradiance.

To arrive at the values at optimum UV irradiance, the following method shall be applied:

Start and operate a lamp through a complete warm-up and using a fast detector, record an erythema effective irradiance plot every second. Determine the maximum erythema effective irradiance over the range 250 nm to 400 nm during the warm-up phase. Cool the lamp to stabilized conditions at the maximum erythema effective irradiance and perform spectral measurements with a double monochromator. Determine the values of X, the total erythema effective UV irradiance over the range 250 nm to 400 nm and Y, the ratio of the NMSC effective UV irradiances ≤ 320 nm and ≥ 320 nm from this spectral measurement.

Annex B
(normative)

Ultraviolet action spectra

The UV action spectra to be applied shall be the erythema and the non-melanoma skin cancer (NMSC) action spectra, as given in IEC 60335-2-27 and in ISO/CIE 28077:2016.

The action spectra are shown graphically in Figure B.1 and the weighting factors $S(\lambda)$ are listed in Table B.1.

NOTE The erythema action spectrum is defined from the following parameters:

Wavelength λ (nm)	**Weighting factor $S(\lambda)$**
$\lambda \leq 298$	1
$298 < \lambda \leq 328$	$10^{0,094(298 - \lambda)}$
$328 < \lambda \leq 400$	$10^{0,015(140 - \lambda)}$

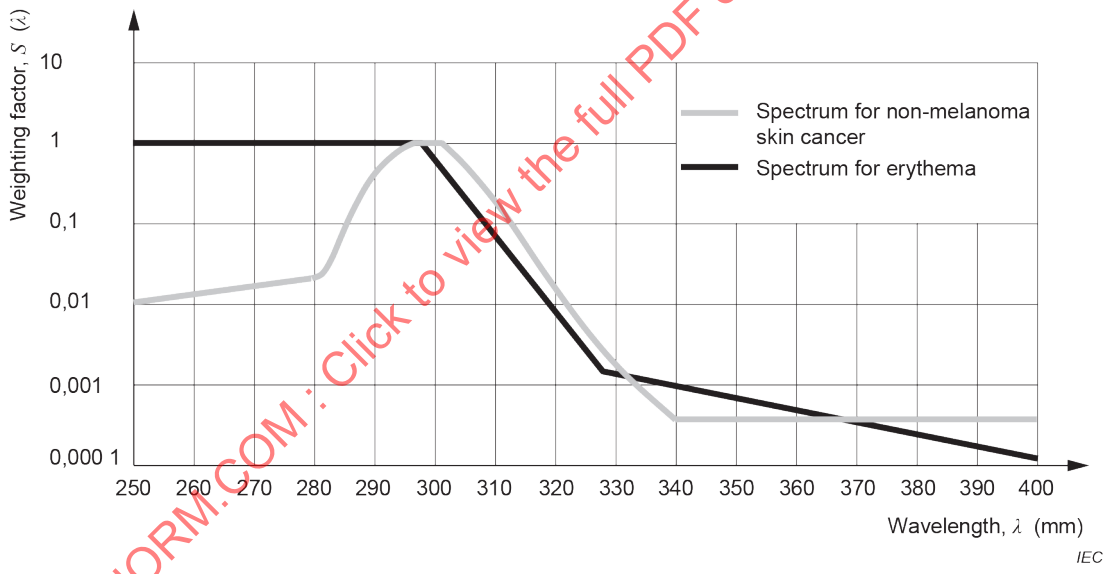


Figure B.1 – UV action spectra for erythema and NMSC

Table B.1 – Weighting factors $S(\lambda)$ for erythema and NMSC action spectrum

Wavelength nm	Weighting factor	
	Erythema	NMSC
250	1,000 000	0,010 900
251	1,000 000	0,011 139
252	1,000 000	0,011 383
253	1,000 000	0,011 633
254	1,000 000	0,011 888
255	1,000 000	0,012 158
256	1,000 000	0,012 435
257	1,000 000	0,012 718
258	1,000 000	0,013 007
259	1,000 000	0,013 303
260	1,000 000	0,013 605
261	1,000 000	0,013 915
262	1,000 000	0,014 231
263	1,000 000	0,014 555
264	1,000 000	0,014 886
265	1,000 000	0,015 225
266	1,000 000	0,015 571
267	1,000 000	0,015 925
268	1,000 000	0,016 287
269	1,000 000	0,016 658
270	1,000 000	0,017 037
271	1,000 000	0,017 424
272	1,000 000	0,017 821
273	1,000 000	0,018 226
274	1,000 000	0,018 641
275	1,000 000	0,019 065
276	1,000 000	0,019 498
277	1,000 000	0,019 942
278	1,000 000	0,020 395
279	1,000 000	0,020 859
280	1,000 000	0,021 334
281	1,000 000	0,025 368
282	1,000 000	0,030 166
283	1,000 000	0,035 871
284	1,000 000	0,057 388
285	1,000 000	0,088 044
286	1,000 000	0,129 670
287	1,000 000	0,183 618
288	1,000 000	0,250 586
289	1,000 000	0,330 048
290	1,000 000	0,420 338
291	1,000 000	0,514 138
292	1,000 000	0,609 954
293	1,000 000	0,703 140
294	1,000 000	0,788 659
295	1,000000	0,861 948
296	1,000 000	0,919 650
297	1,000 000	0,958 965
298	1,000 000	0,988 917
299	0,805 378	1,000 000

Wavelength nm	Weighting factor	
	Erythema	NMSC
300	0,648 634	0,991 996
301	0,522 396	0,967 660
302	0,420 727	0,929 095
303	0,338 844	0,798 410
304	0,272 898	0,677 339
305	0,219 786	0,567 466
306	0,177 011	0,470 257
307	0,142 561	0,385 911
308	0,114 815	0,313 889
309	0,092 469	0,253 391
310	0,074 473	0,203 182
311	0,059 979	0,162 032
312	0,048 306	0,128 671
313	0,038 905	0,101 794
314	0,031 333	0,079 247
315	0,025 235	0,061 659
316	0,020 324	0,047 902
317	0,016 368	0,037 223
318	0,013 183	0,028 934
319	0,010 617	0,022 529
320	0,008 551	0,017 584
321	0,006 887	0,013 758
322	0,005 546	0,010 804
323	0,004 467	0,008 525
324	0,003 597	0,006 756
325	0,002 897	0,005 385
326	0,002 333	0,004 316
327	0,001 879	0,003 483
328	0,001 514	0,002 830
329	0,001 462	0,002 316
330	0,001 413	0,001 911
331	0,001 365	0,001 590
332	0,001 318	0,001 333
333	0,001 274	0,001 129
334	0,001 230	0,000 964
335	0,001 189	0,000 810
336	0,001 148	0,000 688
337	0,001 109	0,000 589
338	0,001 072	0,000 510
339	0,001 035	0,000 446
340	0,001 000	0,000 394
341	0,000 966	0,000 394
342	0,000 933	0,000 394
343	0,000 902	0,000 394
344	0,000 871	0,000 394
345	0,000 841	0,000 394
346	0,000 813	0,000 394
347	0,000 785	0,000 394
348	0,000 759	0,000 394
349	0,000 733	0,000 394

Wavelength nm	Weighting factor	
	Erythema	NMSC
350	0,000 708	0,000 394
351	0,000 684	0,000 394
352	0,000 661	0,000 394
353	0,000 638	0,000 394
354	0,000 617	0,000 394
355	0,000 596	0,000 394
356	0,000 575	0,000 394
357	0,000 556	0,000 394
358	0,000 537	0,000 394
359	0,000 519	0,000 394
360	0,000 501	0,000 394
361	0,000 484	0,000 394
362	0,000 468	0,000 394
363	0,000 452	0,000 394
364	0,000 437	0,000 394
365	0,000 422	0,000 394
366	0,000 407	0,000 394
367	0,000 394	0,000 394
368	0,000 380	0,000 394
369	0,000 367	0,000 394
370	0,000 355	0,000 394
371	0,000 343	0,000 394
372	0,000 331	0,000 394
373	0,000 320	0,000 394
374	0,000 309	0,000 394
375	0,000 299	0,000 394
376	0,000 288	0,000 394
377	0,000 279	0,000 394
378	0,000 269	0,000 394
379	0,000 260	0,000 394
380	0,000 251	0,000 394
381	0,000 243	0,000 394
382	0,000 234	0,000 394
383	0,000 226	0,000 394
384	0,000 219	0,000 394
385	0,000 211	0,000 394
386	0,000 204	0,000 394
387	0,000 197	0,000 394
388	0,000 191	0,000 394
389	0,000 184	0,000 394
390	0,000 178	0,000 394
391	0,000 172	0,000 394
392	0,000 166	0,000 394
393	0,000 160	0,000 394
394	0,000 155	0,000 394
395	0,000 150	0,000 394
396	0,000 145	0,000 394
397	0,000 140	0,000 394
398	0,000 135	0,000 394
399	0,000 130	0,000 394
400	0,000 126	0,000 394

Annex C
(normative)

Method of test for irradiance maintenance

C.1 General

The irradiance at a given time in the life of a lamp shall be measured as specified in Clauses 4, 5 and 6.

During ageing, lamps shall be operated as follows:

- Lamps should preferably be operated at an ambient temperature between 15 °C and 50 °C. Excessive draughts shall be avoided, and the lamps shall not be subjected to extreme vibration and shock.
- Lamps shall be operated in a horizontal position; a vertical position may also be applied.
- The connections of the lamp contacts, with reference to the terminations of the ballast, shall not be changed for the whole course of the tests.
- Lamps shall be operated in the circuit for which they are intended by the manufacturer.
- Lamps shall be switched for ageing. The switching cycle shall be specified by the manufacturer. The OFF-time interval shall not be less than 2 min.

NOTE Typical switching cycles are 25 min ON/5 min OFF or 20 min ON/5 min OFF or 10 min ON/2 min OFF.

C.2 Lamps for operation on AC mains frequencies

Ballasts used to operate lamps at AC mains frequency shall comply with the requirements of IEC 60921. Additionally, for capacitive circuits, the capacitor used shall comply with the requirements of IEC 61049.

The choice of the type of ballasts for these tests is left open, but the type used can have an influence on the results of the test. It is recommended that the type of ballast employed should be stated. In case of doubt, the use of an inductive type of ballast is recommended because such a type has the smallest number of parameters capable of affecting the results.

For lamps operated with a starter, the preheating current, at rated supply voltage, shall not differ by more than 10 % from the rated value specified by the corresponding manufacturer or responsible vendor.

For lamps operated with a starter, the type of starter to be used shall comply with the requirements of IEC 60155, and shall in any case be subject to agreement with the lamp manufacturer or responsible vendor.

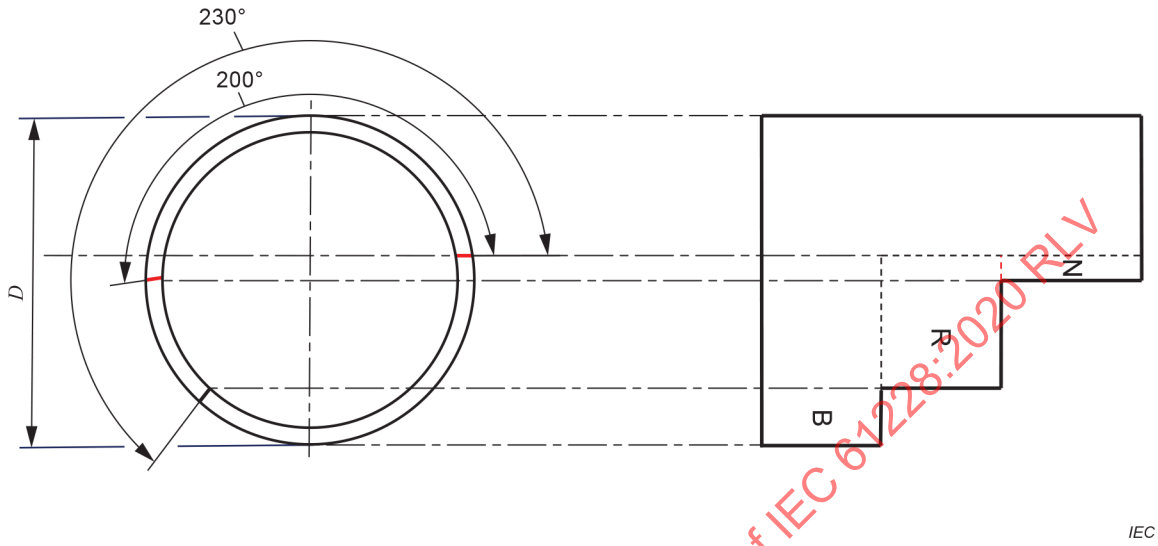
During ageing, the supply voltage and frequency shall not differ by more than 2 % from the rated voltage and frequency of the ballast used.

C.3 Lamps for operation on high frequency

Ballasts used to operate lamps on frequencies above the AC mains frequency shall comply with the requirements of IEC 60929.

Annex D
(normative)

Reflector gauge



Measure	T5 [mm]	T8 [mm]	T12 [mm]	Diameter
D	17	29	41,5	Min.

NOTE Dimensions N, R and B are specified in Clause 8, item b)

Figure D.1 – Reflector gauge

Annex E
(normative)

Lamp datasheets for measurement

The AC mains/supply voltage for the irradiance measurements shall maintain a tolerance of ±0,2 %. The AC mains/supply frequency shall be 50 Hz with a tolerance of ±0,1 % or 60 Hz with a tolerance of ±0,1 %. The AC mains/supply frequency shall be specified for each measurement.

The dimensional provisions A, B, C, D in Table E.1 shall comply with sheet 60081-IEC-01-1 of IEC 60081:1997. Lamps listed in Table E.1 shall comply with the cap dimensions specified in IEC 60061-1. Similarly, the lamp dimensions for the listed lamps in IEC 60061-1 shall comply with the values indicated in Table E.1.

Table E.1 – Lamp dimensions

Lamp type	Nominal power W	Lamp cap[a]	Nominal dimensions mm	A_{max} mm	B_{min} mm	B_{max} mm	C_{max} mm	D_{max}[b] mm
T5 linear fluorescent								
0,300m F12 T5 15W	15	G5	300 x 16	288,3	293,0	295,4	302,5	16,0
0,525m F21 T5 25W	25	G5	525 x 16	516,9	521,6	524,0	531,1	16,0
T12 linear fluorescent								
1,76m F71 T12 100W	100	G13	1 760 x 38	1 763,8	1 768,5	1 770,9	1 778,0	40,5
1,90m F75 T12 120W	120	G13	1 900 x 38	1 901,3	1 905,8	1 908,4	1 915,5	40,5
2,00m F79 T12 120W	120	G13	2 000 x 38	2 001,3	2 005,8	2 008,4	2 015,5	40,5
1,50m F59 T12 140W sm	140	G13	1 500 x 38	1 500,0	1 504,7	1 507,1	1 514,2	40,5
1,50m F59 T12 140W lm	140	G13	1 500 x 38	1 500,0	1 504,7	1 507,1	1 514,2	40,5
1,76m F71 T12 160W sm	160	G13	1 760 x 38	1 763,8	1 768,5	1 770,9	1 778,0	40,5
1,76m F71 T12 160W lm	160	G13	1 760 x 38	1 763,8	1 768,5	1 770,9	1 778,0	40,5
1,90m F75 T12 160W sm	160	G13	1 900 x 38	1 901,3	1 905,8	1 908,4	1 915,5	40,5
1,90m F75 T12 180W sm	180	G13	1 900 x 38	1 901,3	1 905,8	1 908,4	1 915,5	40,5
2,00m F79 T12 180W sm	180	G13	2 000 x 38	2 001,3	2 005,8	2 008,4	2 015,5	40,5
2,00m F79 T12 180W lm	180	G13	2 000 x 38	2 001,3	2 005,8	2 008,4	2 015,5	40,5
2,00m F79 T12 225W lm	225	G13	2 000 x 38	2 001,3	2 005,8	2 008,4	2 015,5	40,5

[a] In accordance with IEC 60061-1.

[b] In accordance with IEC 60081.

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SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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LAMPES FLUORESCENTES À ULTRAVIOLET UTILISÉES POUR LE BRONZAGE – MÉTHODE DE MESURE ET DE SPÉCIFICATION

AVANT-PROPOS

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La Norme internationale IEC 61228 a été établie par le sous-comité 34A: Sources lumineuses électriques, du comité d'études 34 de l'IEC: Eclairage.

Cette troisième édition annule et remplace la deuxième édition parue en 2008. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) code de facteur de conservation: description de l'affaiblissement de l'éclairement UV de la lampe du fait de son utilisation;
b) position de fonctionnement: ajout d'informations pour les lampes à culot unique;
c) système de mesure spectroradiométrique: nouvelles informations concernant la distance entre le capteur et l'axe de la lampe;
d) procédure de mesurage et d'évaluation: informations précises distinctes pour les lampes fluorescentes à UV à deux culots et les lampes fluorescentes à UV à culot unique;

e) Annexe C (normative), Méthode d'essai pour la conservation de l'éclairement: ajout de nouvelles informations;

f) Annexe D (normative), Gabarit du réflecteur: ajout de nouvelles informations;

g) Annexe E (normative), Feuilles de caractéristiques des lampes pour mesurage: ajout d'informations complémentaires.

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

FDIS	Rapport de vote
34A/2213/FDIS	34A/2220/RVD

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.

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LAMPES FLUORESCENTES À ULTRAVIOLET UTILISÉES POUR LE BRONZAGE – MÉTHODE DE MESURE ET DE SPÉCIFICATION

1 Domaine d'application

Le présent document décrit la méthode pour mesurer, évaluer et spécifier les caractéristiques de rayonnement UV des lampes fluorescentes à UV utilisées dans les appareils de bronzage. Il inclut des exigences particulières concernant le marquage de telles lampes.

Ces exigences ne concernent que les essais de type.

Les lampes conformes aux exigences du présent document satisfont aux exigences de sécurité électrique et mécanique de l'IEC 61195 et de l'IEC 61199, à l'exception des exigences relatives aux limites maximales de rayonnement UV.

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 60061-1, *Culots de lampes et douilles ainsi que calibres pour le contrôle de l'interchangeabilité et de la sécurité – Partie 1: Culots de lampes*

IEC 60081, *Lampes à fluorescence à deux culots – Prescriptions de performance*

IEC 60155, *Interrupteurs d'amorçage à lueur pour lampes à fluorescence (starters)*

IEC 60335-2-27, *Appareils électrodomestiques et analogues – Sécurité – Partie 2-27: Exigences particulières pour les appareils d'exposition de la peau aux rayonnements optiques*

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

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

IEC 61049, *Condensateurs destinés à être utilisés dans les circuits de lampes tubulaires à fluorescence et autres lampes à décharge. Prescriptions de performance*

ISO/CIE 28077:2016, *Photocarcinogenesis action spectrum (non-melanoma skin cancers)* (disponible en anglais seulement)

CIE 63:1984, *The spectroradiometric measurement of light sources* (disponible en anglais seulement)

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
lampe à ultraviolet
source artificielle produisant un rayonnement surtout riche en radiations ultraviolettes et dont les qualités lumineuses éventuelles ne sont pas directement recherchées

[SOURCE: IEC 60050-845:1987, 845-07-52, modifiée – Note supprimée.]

3.2
lampe fluorescente
lampe 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

[SOURCE: IEC 60050-845:1987, 845-07-26, modifiée – Note supprimée.]

3.3
spectroradiomètre
appareil destiné à la mesure des grandeurs radiométriques dans des intervalles étroits de longueur d'onde sur un domaine spectral donné

[SOURCE: IEC 60050-845:1987, 845-05-07]

3.4
largeur de bande à une longueur d'onde donnée
largeur entre les points de demi-amplitude, de la fonction transmission d'un monochromateur

Note 1 à l'article: La largeur de bande est exprimée en nm.

3.5
spectral
qualificatif qui, lorsqu'il est appliqué à une grandeur X appartenant à un rayonnement électromagnétique, indique:

– soit que X est une fonction de la longueur d'onde λ, symbole: $X(\lambda)$;

– soit que la grandeur considérée est la densité spectrale de X, symbole: $X_\lambda = \mathrm{d}X/\mathrm{d}\lambda$.

X_λ étant aussi une fonction de λ, on peut l'écrire X_λ (λ) sans que son sens soit changé, simplement pour souligner ce fait

[SOURCE: IEC 60050-845:1987, 845-01-16, modifiée – Note supprimée.]

3.6
éclairement énergétique
quotient du flux énergétique $\mathrm{d}\phi_e$ reçu par un élément de la surface contenant le point, par l'aire $\mathrm{d}A$ de cet élément

Note 1 à l'article: L'éclairement énergétique est exprimé en W/m^2.

[SOURCE: IEC 60050-845:1987, 845-01-37, modifiée – Domaine et définition équivalente supprimés.]

3.7
spectre d'action
efficacité des radiations monochromatiques pour produire un phénomène spécifié sur un système spécifié

[SOURCE: IEC 60050-845:1987, 845-06-14, modifiée – Définition révisée.]

3.8
effectif
qualificatif qui, lorsqu'il est appliqué à une grandeur appartenant à un rayonnement électromagnétique, indique que ladite grandeur est pondérée en fonction d'un spectre d'action déterminé

3.9
valeur nominale
valeur approchée d'une grandeur, utilisée pour dénommer ou identifier une lampe

[SOURCE: IEC 60050-151:2001, 151-16-09, modifiée – Définition révisée et note supprimée.]

3.10
valeur assignée
valeur d'une grandeur pour une caractéristique d'une lampe dans des conditions de fonctionnement spécifiées

Note 1 à l'article: La valeur et/ou les conditions sont spécifiées dans le présent document ou fixées par le fabricant ou le vendeur responsable.

3.11
rapport de conservation de l'éclairement énergétique
r
valeur assignée du rapport de l'éclairement énergétique UV effectif pondéré selon le spectre d'action pour l'érythème (250 nm à 400 nm) à un moment spécifié aux valeurs initiales

3.12
valeur initiale
caractéristiques électriques et radiométriques mesurées à la fin d'une période de vieillissement de 5 h

3.13
code de facteur de conservation
description de l'affaiblissement de l'éclairement UV de la lampe du fait de son utilisation pendant 5 h à 500 h

4 Conditions générales d'essai

4.1 Vieillissement

Avant d'effectuer les mesurages initiaux, les lampes doivent être vieillies pendant une durée de 5 h ± 0,25 h.

Le vieillissement doit être effectué conformément à l'Annexe C.

4.2 Position de fonctionnement

Pendant les mesurages, les lampes doivent fonctionner en position horizontale. Le vieillissement s'effectue de préférence en position horizontale; une position verticale peut aussi être appliquée.

Les lampes à culot unique doivent être positionnées de façon que le capteur soit placé face aux deux branches de la lampe (voir Figure 1). Si la lampe possède plus de deux branches, le fabricant ou le vendeur responsable doit spécifier la position de mesure.

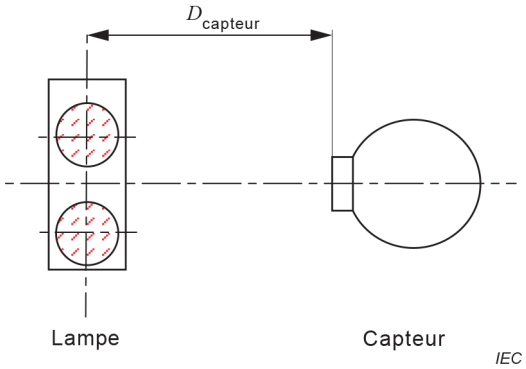

Figure 1 – Position de mesure des lampes à culot unique

NOTE L'orientation de la lampe dans les appareils d'exposition de la peau aux rayonnements ultraviolets (bancs solaires) peut être différente de la position de mesure. Les valeurs d'éclairement énergétique peuvent donc aussi être différentes.

4.3 Température ambiante

Les mesurages doivent être effectués dans une atmosphère à l'abri des courants d'air, à une température ambiante de 25 °C ± 1 °C.

Si cela est applicable, les lampes peuvent également être mesurées dans des conditions différentes des conditions de température ambiante normalisées ci-dessus pour établir l'éclairement énergétique optimal, comme cela est décrit à l'Annexe A.

4.4 Tension d'essai

Tous les mesurages doivent être effectués en appliquant le circuit d'essai de la Figure 2 (amorçage par préchauffage).

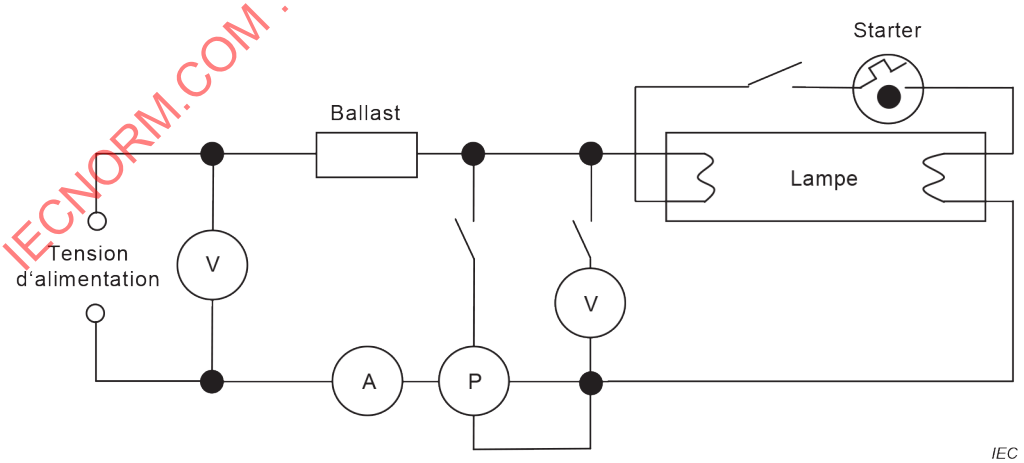

Figure 2 – Circuit d'essai

La tension d'essai appliquée au circuit doit être égale à 110 % de la tension assignée du ballast de référence, le circuit d'amorçage étant fermé en continu.

La tension d'alimentation en courant alternatif pour les mesures de l'éclairement doit respecter une tolérance de ± 0,2 %.

La fréquence d'alimentation en courant alternatif doit être de 50 Hz ± 0,1 % ou 60 Hz ± 0,1 % pour chaque mesurage.

4.5 Ballast

Les lampes doivent fonctionner avec un ballast qui génère des valeurs électriques pour le fonctionnement de la lampe concernée conformes aux valeurs données par le fabricant ou le vendeur responsable de la lampe correspondante.

Le ballast doit fonctionner à une fréquence de 50 Hz ou 60 Hz. La fréquence doit être spécifiée pour chaque mesurage.

5 Exigences d'essai

5.1 Généralités

Les mesurages spectroradiométriques doivent être réalisés conformément aux recommandations correspondantes de la CIE (Commission internationale de l'éclairage), données dans la CIE 63.

NOTE 1 Des renseignements complémentaires relatifs aux mesurages UV sont donnés à l'Annexe B de l'IEC 62471:2006.

NOTE 2 Des exigences complémentaires pour les mesurages électriques sont données à l'Annexe B de l'IEC 60081:1997, l'Annexe B de l'IEC 60081:1997/AMD2:2003, l'Annexe B de l'IEC 60081:1997/AMD4:2010, l'Annexe B de l'IEC 60081:1997/AMD5:2013, à l'Annexe B de l'IEC 60901:1996, l'Annexe B de l'IEC 60901:1996/AMD2:2000, l'Annexe B de l'IEC 60901:1996/AMD5:2011 et à l'Annexe B de l'IEC 60901:1996/AMD6:2014.

5.2 Système de mesure spectroradiométrique

Les lampes doivent être mesurées dans un système spectroradiométrique qui permet d'obtenir l'éclairement énergétique spectral.

L'optique d'entrée du système doit avoir une réponse en cosinus de façon à mesurer avec précision l'éclairement énergétique.

Le spectroradiomètre doit avoir une largeur de bande qui n'excède pas 2,5 nm et sa résolution de longueur d'onde ne doit pas être supérieure à 1 nm.

La distance entre le capteur et l'axe de la lampe, D_{capteur}, doit être de (25 ± 0,5) cm (voir Figure 1).

NOTE Une largeur de bande d'une longueur d'onde donnée de 1 nm est privilégiée pour une plus grande précision de mesure dans les cas où une variation rapide de l'éclairement spectral se produit dans une petite largeur de bande.

6 Procédure de mesurage et d'évaluation

6.1 Mesurage

6.1.1 Généralités

L'éclairement énergétique spectral doit être mesuré à des intervalles de 1 nm entre 250 nm et 400 nm. La puissance de la lampe, le courant et la tension dans les conditions d'essai doivent être enregistrés. La lampe doit être placée dans des conditions électriques et radiométriques stables.