Fluorescent ultraviolet lamps used for tanning — Measurement and specification method

 $ICS\ 17.240;\ 29.140.30;\ 97.170$



National foreword

This British Standard is the UK implementation of EN 61228:2008. It is identical to IEC 61228:2008. It supersedes BS EN 61228:1995 which will be withdrawn on 1 February 2011.

The UK participation in its preparation was entrusted by Technical Committee CPL/34, Lamps and related equipment, to Subcommittee CPL/34/1, Electric lamps.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 April 2008

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ISBN 978 0 580 57614 0

Amendments/corrigenda issued since publication

Date	Comments

EUROPEAN STANDARD

EN 61228

NORME EUROPÉENNE EUROPÄISCHE NORM

March 2008

ICS 17.240; 29.140.01; 97.170

Supersedes EN 61228:1994 + A1:1996

English version

Fluorescent ultraviolet lamps used for tanning - Measurement and specification method

(IEC 61228:2008)

Lampes fluorescentes à ultraviolet utilisées pour le bronzage - Méthode de mesure et de spécification (CEI 61228:2008)

UV-Leuchtstofflampen für Bräunungszwecke -Verfahren zur Messung und Beschreibung (IEC 61228:2008)

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CENELEC

European Committee for Electrotechnical Standardization Comité Européen de Normalisation Electrotechnique Europäisches Komitee für Elektrotechnische Normung

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

Foreword

The text of document 34A/1242/FDIS, future edition 2 of IEC 61228, prepared by SC 34A, Lamps, of IEC TC 34, Lamps and related equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61228 on 2008-02-01.

This European Standard supersedes EN 61228:1994 + A1:1996.

In EN 61128:2008, an equivalency code for the lamps is introduced. This equivalency code characterises the spectral energy distribution and is to be applied when replacing lamps in tanning equipment.

The following dates were fixed:

 latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement

(dop) 2008-11-01

 latest date by which the national standards conflicting with the EN have to be withdrawn

(dow) 2011-02-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61228:2008 was approved by CENELEC as a European Standard without any modification.

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FLUORESCENT ULTRAVIOLET LAMPS USED FOR TANNING – MEASUREMENT AND SPECIFICATION METHOD

1 Scope

This International Standard describes the method of measuring, evaluating and specifying the 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 relate only to type testing.

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

IEC 60081, Double-capped fluorescent lamps – Performance specifications

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 radiation

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.

3.1

ultraviolet lamp

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

[IEV 845-07-52]

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

[IEV 845-07-26]

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

3.4

spectroradiometer

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

[IEV 845-05-07]

3.5

bandwidth at a given wavelength

width at half-amplitude points of the transmittance function of a monochromator (unit: nm)

3.6

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: $X_{\lambda} = dX/d\lambda$.

 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

[IEV 845-01-16]

3.7

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 (unit: W/m²)

[IEV 845-01-37]

3.8

action spectrum

efficiency of monochromatic radiations for producing a specified phenomenon in a specified system

[IEV 845-06-14, modified]

3.9

effective

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

3.10

nominal value

approximate quantity value used to designate or identify a lamp

3.11

rated value

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

NOTE The value and/or conditions are specified in this standard, or assigned by the manufacture or responsible vendor.

4 General test conditions

4.1 Ageing

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

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.

4.3 Ambient temperature

The measurement shall be made in a draught-free atmosphere at an ambient temperature of 25 $^{\circ}$ C \pm 1 $^{\circ}$ 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

The test voltage applied to the circuit shall be as specified on the relevant lamp data sheet.

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.

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.

Additional information about UV measurements is given in Annex B of IEC 62471.

Requirements for electrical measurements are given in Annex B of IEC 60081 and IEC 60901.

5.2 Spectroradiometric measuring system

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

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

The spectroradiometer shall have a bandwidth not exceeding 2,5 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)

6 Measurement and evaluation procedure

6.1 Measurement

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.

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:

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

where

 E_{eff} is the total effective irradiance (W/m²);

 E_{λ} is the spectral irradiance (W/(m².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.

The applicable action spectra for erythema and 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 $\leq \lambda \leq$ 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 $\leq \lambda \leq$ 320 nm, and

320 nm < $\lambda \le 400$ nm.

NOTE 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.

6.3 Correction factors

In order to arrive at the final total effective UV irradiance values, the following two correction factors 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.

7 Lamp specification

The following information shall be given for each lamp type in the manufacturers literature:

- 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 for which the lamp is designed;
- d) the rated electrical characteristics:
 - lamp wattage;
 - lamp current;
 - lamp voltage;
- e) three rated total effective UV irradiance values at 25 cm distance from the lamp axis and weighted according to Annex B:
 - the erythema action spectrum over the wavelength range 250 nm $\leq \lambda \leq$ 400 nm;
 - the NMSC action spectrum over the wavelength range 250 nm $\leq \lambda \leq$ 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/m² 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 trade mark, 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".
 - 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 $\alpha > 230^{\circ}$;
 - N for lamps with a narrow reflector angle α < 200°;
 - R for lamps with a regular reflector $200^{\circ} \le \alpha \le 230^{\circ}$.

- 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 - 400 nm;

 $Y = \text{ratio of the NMSC effective UV irradiances} \le 320 \text{ nm and} > 320 \text{ nm}.$

X is to be given in mW/m² rounded to the nearest integer, Y is to be rounded to the nearest first decimal. The effective values are at 25 cm distance and under conditions of optimum UV irradiance.

EXAMPLE

100 W reflector lamp with 220° reflector angle

erythema effective UV irradiance (250 nm - 400 nm) = 47 mW/m²

short wave NMSC effective UV irradiance (≤ 320 nm) = 61 mW/m²

long wave NMSC effective UV irradiance (> 320 nm) = 19 mW/m²

Equivalency code: 100-R-47/3,2

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 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.

Annex B (normative)

Ultraviolet action spectra

The UV action spectra to be applied are the erythema and the NMSC (non-melanoma skin cancer) action spectra, as given in IEC 60335-2-27.

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 - λ)}
$328 < \lambda \le 400$	$10^{0.015(140 - \lambda)}$

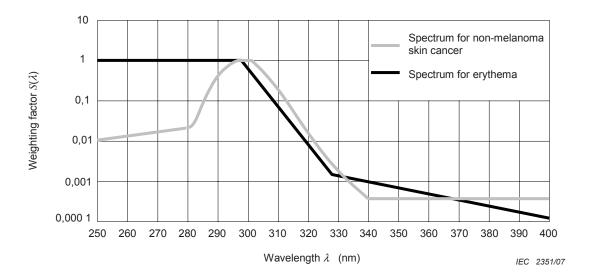


Figure B.1 – UV action spectra for erythema and NMSC

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

Prythems	Wavelength	Weighti	ng factor	Wavelength	elength Weighting factor			Wavelength	Weighting factor	
250	nm	Erythema	NMSC	nm	Erythema	NMSC		nm	Erythema	NMSC
251 1,000000 0,01138 301 0,52296 0,967660 351 0,00084 0,00034		1.000000	0.010900		0.648634	0.991996	H		0.000708	0.000394
252		,					H			0,000394
253							F			
255				303		0,798410	f			
256	254	1,000000	0,011888	304	0,272898	0,677339	H	354	0,000617	0,000394
257 1,000000 0,012718 307 0,142561 0,385911 357 0,000394 0,000394 258 1,000000 0,013007 308 0,114815 0,313889 358 0,000537 0,000394 260 1,000000 0,013005 310 0,074473 0,203182 360 0,000591 0,000394 261 1,000000 0,014231 311 0,059979 0,162032 361 0,000484 0,000394 263 1,000000 0,014555 313 0,338905 0,101794 363 0,000484 0,000394 264 1,000000 0,014525 315 0,02525 0,0161699 366 0,000437 0,000394 266 1,000000 0,015225 317 0,016386 0,037223 366 0,000477 0,000394 267 1,000000 0,016287 317 0,0163686 0,037223 366 0,000477 0,000394 268 1,0000000 0,016287 318 0,013183 <	255	1,000000	0,012158	305	0,219786	0,567466	Ħ	355	0,000596	0,000394
258 1,000000 0,013007 308 0,114815 0,313889 358 0,000537 0,000394 260 1,000000 0,013005 309 0,092469 0,253391 359 0,000519 0,000394 261 1,000000 0,013015 311 0,059979 0,162032 361 0,000484 0,000394 262 1,000000 0,014231 312 0,048306 0,128671 362 0,000488 0,000394 264 1,000000 0,014855 314 0,033333 0,079247 364 0,000482 0,000394 265 1,000000 0,015225 315 0,025235 0,061659 365 0,000462 0,000394 266 1,000000 0,015225 315 0,025235 0,061659 365 0,000422 0,000394 266 1,000000 0,015275 316 0,020324 0,047902 366 0,000402 0,000394 268 1,000000 0,015275 318 0,013688 0,037223 367 0,000394 0,000394 269 1,000000 0,016287 318 0,013183 0,028934 368 0,000384 0,000394 270 1,000000 0,017037 320 0,008551 0,017584 370 0,000355 0,000394 271 1,000000 0,017821 322 0,008561 0,017588 371 0,000343 0,000394 272 1,000000 0,017821 322 0,008561 0,017588 371 0,000343 0,000394 273 1,000000 0,018226 323 0,004467 0,006525 373 0,000320 0,000394 274 1,000000 0,018226 323 0,004467 0,006525 373 0,000339 0,000394 274 1,000000 0,018287 326 0,002333 0,00354 375 0,000399 0,000394 276 1,000000 0,018286 323 0,004467 0,006525 373 0,000320 0,000394 276 1,000000 0,018286 326 0,002333 0,00334 377 0,000299 0,000394 276 1,000000 0,01848 324 0,003597 0,006365 375 0,000299 0,000394 276 1,000000 0,01848 326 0,002333 0,00334 377 0,000299 0,000394 276 1,000000 0,01848 332 0,001450 0,00334 377 0,000290 0,000394 277 1,000000 0,01848 332 0,001450 0,000394 377 0,000290 0,000394 277 1,000000 0,01848 332 0,001450 0,000394 383 0,000250 0,000394 283 1,000000 0,03586 333 0,001148 0,000394 385 0,000260 0,000394 386 0,000244 0,000394 386 0,00	256	1,000000	0,012435	306	0,177011	0,470257	F	356	0,000575	0,000394
259	257	1,000000	0,012718	307	0,142561	0,385911	Ħ	357	0,000556	0,000394
280 1,000000 0,013805 310 0,074473 0,203182 360 0,000394 0,000394 261 1,000000 0,014251 311 0,059979 0,162032 361 0,000484 0,000394 263 1,000000 0,014855 313 0,038905 0,101794 363 0,000482 0,000394 264 1,000000 0,014856 314 0,031333 0,079247 384 0,000437 0,000394 266 1,000000 0,015571 316 0,020324 0,047902 366 0,000477 0,000394 267 1,000000 0,015627 318 0,0133183 0,02324 366 0,000477 0,000394 268 1,000000 0,0166287 318 0,013617 0,022529 366 0,000344 0,000394 270 1,000000 0,017627 322 0,00851 0,017584 371 0,000394 271 1,000000 0,017824 322 0,008546 0,01894	258	1,000000	0,013007	308	0,114815	0,313889	F	358	0,000537	0,000394
281 1,000000 0,013915 311 0,059979 0,162032 361 0,000484 0,000394 262 1,000000 0,014231 312 0,043306 0,128671 362 0,000488 0,000394 264 1,000000 0,014886 314 0,031333 0,079247 364 0,000437 0,000394 265 1,000000 0,015225 315 0,025235 0,061659 366 0,000437 0,000394 266 1,000000 0,015925 317 0,016386 0,037223 367 0,00394 0,000394 268 1,000000 0,015925 317 0,016386 0,037223 367 0,000394 0,000394 269 1,000000 0,017621 320 0,00851 0,017584 370 0,00337 0,000394 270 1,000000 0,017821 322 0,005546 0,017826 373 0,000394 0,000394 271 1,000000 0,017821 322 0,005546 0,	259	1,000000	0,013303	309	0,092469	0,253391	F	359	0,000519	0,000394
282 1,000000 0,014231 312 0,048306 0,128671 362 0,000488 0,000394 283 1,000000 0,014856 314 0,033905 0,101794 363 0,000422 0,000394 285 1,000000 0,015825 315 0,028235 0,081659 365 0,000422 0,000394 286 1,000000 0,015825 317 0,016868 0,037223 366 0,000422 0,000394 286 1,000000 0,016827 318 0,013183 0,028924 368 0,000380 0,000394 289 1,000000 0,016868 319 0,010617 0,028924 368 0,000380 0,000394 270 1,000000 0,017424 321 0,008887 0,13788 371 0,000365 0,000394 272 1,000000 0,017821 322 0,00546 0,018046 372 0,000334 0,00334 273 1,000000 0,01826 323 0,004467 0,0	260	1,000000	0,013605	310	0,074473	0,203182	Ħ	360	0,000501	0,000394
263 1,000000 0,014555 313 0,038905 0,101794 363 0,000394 0,000394 264 1,000000 0,014886 314 0,031333 0,079247 364 0,000437 0,000394 265 1,000000 0,015571 315 0,025235 0,061659 366 0,000407 0,000394 267 1,000000 0,015825 317 0,016386 0,037223 367 0,000394 0,000394 268 1,000000 0,016287 318 0,013183 0,02834 368 0,000394 0,000394 270 1,000000 0,017037 320 0,008551 0,017584 370 0,000394 0,00394 271 1,000000 0,017821 322 0,005867 371 0,000394 372 0,000394 273 1,000000 0,018226 323 0,004467 0,005385 371 0,000394 275 1,000000 0,018641 324 0,003597 0,006525 373 <td>261</td> <td>1,000000</td> <td>0,013915</td> <td>311</td> <td>0,059979</td> <td>0,162032</td> <td>F</td> <td>361</td> <td>0,000484</td> <td>0,000394</td>	261	1,000000	0,013915	311	0,059979	0,162032	F	361	0,000484	0,000394
264 1,000000 0,014886 314 0,031333 0,079247 364 0,000394 0,000394 265 1,000000 0,015275 315 0,025235 0,061659 365 0,000422 0,000394 267 1,000000 0,015257 316 0,020324 0,047902 366 0,000477 0,000394 268 1,000000 0,016287 318 0,013183 0,028934 366 0,000394 0,000394 269 1,000000 0,017628 319 0,016618 319 0,016617 0,022529 369 0,000367 0,000394 271 1,000000 0,017821 321 0,008551 0,017864 370 0,000367 0,000394 273 1,000000 0,018226 323 0,004467 0,008525 373 0,000331 0,000394 274 1,000000 0,018641 324 0,005596 373 0,000394 377 0,000394 275 1,000000 0,01942 327 </td <td>262</td> <td>1,000000</td> <td>0,014231</td> <td>312</td> <td>0,048306</td> <td>0,128671</td> <td>f</td> <td>362</td> <td>0,000468</td> <td>0,000394</td>	262	1,000000	0,014231	312	0,048306	0,128671	f	362	0,000468	0,000394
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266	264	1,000000	0,014886	314	0,031333	0,079247	F	364	0,000437	0,000394
267 1,000000 0,015925 317 0,016368 0,037223 367 0,000394 0,000394 268 1,000000 0,016287 318 0,013183 0,028934 368 0,000380 0,000394 270 1,000000 0,017037 320 0,008551 0,017584 370 0,000355 0,000394 271 1,000000 0,017424 321 0,00857 0,013758 371 0,000334 0,000394 272 1,000000 0,017821 322 0,005548 0,010804 372 0,000331 0,000394 273 1,000000 0,018226 323 0,004467 0,008525 373 0,000331 0,000394 274 1,000000 0,018641 324 0,003597 0,006756 374 0,000398 276 1,000000 0,019498 326 0,002333 0,04316 376 0,000286 0,000394 277 1,000000 0,020855 328 0,001437 0,00260 0,000394 <td>265</td> <td>1,000000</td> <td>0,015225</td> <td>315</td> <td>0,025235</td> <td>0,061659</td> <td>t</td> <td>365</td> <td>0,000422</td> <td>0,000394</td>	265	1,000000	0,015225	315	0,025235	0,061659	t	365	0,000422	0,000394
268	266	1,000000	0,015571	316	0,020324	0,047902	F	366	0,000407	0,000394
269	267	1,000000	0,015925	317	0,016368	0,037223	Ħ	367	0,000394	0,000394
270	268	1,000000	0,016287	318	0,013183	0,028934	H	368	0,000380	0,000394
271 1,000000 0,017424 321 0,006887 0,013758 371 0,000343 0,000394 272 1,000000 0,018226 322 0,005546 0,010804 372 0,000331 0,000394 273 1,000000 0,018641 324 0,003597 0,006526 373 0,000320 0,000394 275 1,000000 0,018641 324 0,003597 0,0065385 376 0,000399 0,000394 276 1,000000 0,019498 326 0,02333 0,004316 376 0,000299 0,000394 277 1,000000 0,020395 328 0,001679 0,003483 377 0,000279 0,000394 279 1,000000 0,020334 330 0,001461 0,002830 378 0,000269 0,000394 280 1,000000 0,025368 331 0,001413 0,001911 380 0,000251 0,000394 282 1,000000 0,057368 332 0,01318	269	1,000000	0,016658	319	0,010617	0,022529	F	369	0,000367	0,000394
272 1,000000 0,017821 322 0,005546 0,010804 372 0,000331 0,000394 273 1,000000 0,018226 323 0,004467 0,008525 373 0,000320 0,000394 275 1,000000 0,019065 325 0,002897 0,00585 375 0,000299 0,000394 276 1,000000 0,019482 327 0,0014879 0,003483 376 0,000289 0,000394 277 1,000000 0,019422 327 0,001879 0,003483 377 0,000229 0,000394 278 1,000000 0,020859 328 0,001514 0,002830 378 0,000289 0,000394 280 1,000000 0,025368 331 0,001462 0,00231 380 0,000243 381 0,000243 0,000394 282 1,000000 0,035871 333 0,001413 0,001394 382 0,000394 383 0,000243 0,000394 383 0,000243 <t< td=""><td>270</td><td>1,000000</td><td>0,017037</td><td>320</td><td>0,008551</td><td>0,017584</td><td>Ħ</td><td>370</td><td>0,000355</td><td>0,000394</td></t<>	270	1,000000	0,017037	320	0,008551	0,017584	Ħ	370	0,000355	0,000394
273 1,000000 0.018226 323 0.004467 0.008525 373 0.000320 0,000394 274 1,000000 0.018641 324 0.003597 0.006756 374 0,000309 0,000394 275 1,000000 0.019498 325 0,002897 0.005385 375 0,000299 0,000394 276 1,000000 0.019498 326 0,002333 3,004316 376 0,000288 0,000394 277 1,000000 0,020395 328 0,001514 0,002830 378 0,000269 0,000394 279 1,000000 0,020859 329 0,001462 0,002316 379 0,000260 0,000394 280 1,000000 0,025388 331 0,001365 0,001519 381 0,000243 0,000394 281 1,000000 0,035871 333 0,001274 0,001199 381 0,000243 0,000394 284 1,000000 0,057388 334 0,00129	271	1,000000	0,017424	321	0,006887	0,013758	F	371	0,000343	0,000394
274 1,000000 0,018641 324 0,003597 0,006756 374 0,000309 0,000394 275 1,000000 0,019065 325 0,002897 0,005385 375 0,000299 0,000394 276 1,000000 0,019498 326 0,002333 0,004316 376 0,000288 0,000394 277 1,000000 0,020395 328 0,001514 0,002830 378 0,000269 0,000394 279 1,000000 0,020359 328 0,001514 0,002316 379 0,000260 0,000394 280 1,000000 0,025368 331 0,001462 0,00251 380 0,000243 0,000394 281 1,000000 0,03566 332 0,001318 0,001590 381 0,000243 0,000394 282 1,000000 0,057388 334 0,001244 0,001129 383 0,000226 0,000394 283 1,000000 0,057388 334 0,00146 38	272	1,000000	0,017821	322	0,005546	0,010804	f	372	0,000331	0,000394
275	273	1,000000	0,018226	323	0,004467	0,008525	F	373	0,000320	0,000394
276	274	1,000000	0,018641	324	0,003597	0,006756	F	374	0,000309	0,000394
277 1,000000 0,019942 327 0,001879 0,003483 377 0,000279 0,000394 278 1,00000 0,020395 328 0,001514 0,002830 378 0,000269 0,000394 279 1,00000 0,02334 329 0,001462 0,002316 379 0,000260 0,000394 280 1,00000 0,025368 331 0,001462 0,001394 380 0,000251 0,000394 281 1,00000 0,030166 332 0,001318 0,001333 382 0,000243 0,000394 283 1,000000 0,055388 334 0,001274 0,001129 383 0,000226 0,000394 284 1,000000 0,055388 334 0,001230 0,00064 384 0,000219 0,000394 285 1,000000 0,088044 335 0,001189 0,000688 386 0,000211 0,000394 286 1,000000 0,250586 338 0,00119 0,0005	275	1,000000	0,019065	325	0,002897	0,005385	ħ	375	0,000299	0,000394
278 1,000000 0,020395 328 0,001514 0,002830 378 0,000269 0,000394 279 1,000000 0,02859 329 0,001462 0,002316 379 0,000260 0,000394 280 1,000000 0,025368 331 0,001413 0,001911 380 0,000243 0,000394 281 1,000000 0,035871 332 0,001318 0,001333 382 0,000234 0,000394 283 1,000000 0,035871 333 0,001274 0,001129 383 0,000226 0,000394 284 1,000000 0,057388 334 0,001230 0,000964 384 0,000219 0,000394 285 1,000000 0,129670 336 0,001188 0,000810 385 0,000214 0,000394 288 1,000000 0,183618 337 0,001109 0,000589 387 0,000197 0,000394 289 1,000000 0,250586 338 0,00107 0	276	1,000000	0,019498	326	0,002333	0,004316	F	376	0,000288	0,000394
279 1,000000 0,020859 329 0,001462 0,002316 379 0,000260 0,000394 280 1,000000 0,021334 330 0,001413 0,001911 380 0,000251 0,000394 281 1,000000 0,03568 331 0,001365 0,001590 381 0,000243 0,000394 282 1,00000 0,035871 333 0,001274 0,001129 383 0,000266 0,000394 284 1,00000 0,057388 334 0,001230 0,000964 384 0,000219 0,000394 285 1,00000 0,129670 336 0,001148 0,00088 386 0,000214 0,000394 286 1,000000 0,183618 337 0,001199 0,000589 387 0,000197 0,000394 288 1,000000 0,250586 338 0,00172 0,000510 388 0,000197 0,000394 289 1,000000 0,514138 341 0,000394 390 </td <td>277</td> <td>1,000000</td> <td>0,019942</td> <td>327</td> <td>0,001879</td> <td>0,003483</td> <td>ħ</td> <td>377</td> <td>0,000279</td> <td>0,000394</td>	277	1,000000	0,019942	327	0,001879	0,003483	ħ	377	0,000279	0,000394
280 1,000000 0,021334 330 0,001413 0,001911 380 0,000251 0,000394 281 1,00000 0,025368 331 0,001365 0,001590 381 0,000243 0,000394 282 1,00000 0,035871 332 0,001318 0,001333 382 0,000234 0,000394 284 1,00000 0,057388 334 0,001230 0,000964 384 0,000219 0,000394 285 1,00000 0,129670 336 0,001148 0,00088 386 0,000211 0,000394 286 1,00000 0,129670 336 0,001148 0,00088 386 0,000204 0,000394 287 1,000000 0,183618 337 0,001109 0,000589 387 0,000197 0,000394 288 1,000000 0,250586 338 0,001072 0,000510 388 0,000197 0,000394 290 1,000000 0,514138 341 0,000394 390 <td>278</td> <td>1,000000</td> <td>0,020395</td> <td>328</td> <td>0,001514</td> <td>0,002830</td> <td>F</td> <td>378</td> <td>0,000269</td> <td>0,000394</td>	278	1,000000	0,020395	328	0,001514	0,002830	F	378	0,000269	0,000394
281 1,000000 0,025368 331 0,001365 0,001590 381 0,000243 0,000394 282 1,000000 0,035871 332 0,001318 0,001274 0,001129 383 0,000226 0,000394 284 1,000000 0,057388 334 0,001230 0,000964 384 0,000219 0,000394 285 1,000000 0,129670 336 0,001148 0,000688 386 0,000204 0,000394 287 1,000000 0,183618 337 0,001199 0,000589 387 0,000197 0,000394 288 1,000000 0,330048 339 0,001072 0,000510 388 0,000197 0,000394 289 1,000000 0,420338 340 0,001035 0,000446 389 0,000184 0,000394 291 1,000000 0,514138 341 0,000966 0,000394 391 0,000172 0,000394 293 1,000000 0,703140 343 <td< td=""><td>279</td><td>1,000000</td><td>0,020859</td><td>329</td><td>0,001462</td><td>0,002316</td><td>Ī</td><td>379</td><td>0,000260</td><td>0,000394</td></td<>	279	1,000000	0,020859	329	0,001462	0,002316	Ī	379	0,000260	0,000394
282 1,000000 0,030166 332 0,001318 0,001333 382 0,000234 0,000394 283 1,000000 0,057388 334 0,001274 0,001129 383 0,000226 0,000394 285 1,000000 0,088044 335 0,001189 0,000810 385 0,000211 0,000394 286 1,00000 0,129670 336 0,001148 0,000688 386 0,000204 0,000394 287 1,000000 0,183618 337 0,001109 0,000589 387 0,000197 0,000394 288 1,000000 0,250586 338 0,001072 0,000510 388 0,000191 0,000394 289 1,000000 0,330048 339 0,001035 0,000446 389 0,000184 0,000394 291 1,000000 0,514138 341 0,0009394 391 0,000172 0,000394 292 1,000000 0,703140 343 0,000933 0,000394 <td< td=""><td>280</td><td>1,000000</td><td>0,021334</td><td>330</td><td>0,001413</td><td>0,001911</td><td>F</td><td>380</td><td>0,000251</td><td>0,000394</td></td<>	280	1,000000	0,021334	330	0,001413	0,001911	F	380	0,000251	0,000394
283 1,000000 0,035871 333 0,001274 0,001129 383 0,000226 0,000394 284 1,000000 0,057388 334 0,001230 0,000964 384 0,000219 0,000394 285 1,000000 0,088044 335 0,001189 0,000810 385 0,000211 0,000394 286 1,000000 0,183618 337 0,001109 0,000589 387 0,000197 0,000394 288 1,000000 0,250586 338 0,001072 0,000510 388 0,000197 0,000394 289 1,000000 0,330048 339 0,001035 0,000446 389 0,000184 0,000394 290 1,000000 0,514138 341 0,000966 0,000394 390 0,000172 0,000394 292 1,000000 0,609954 342 0,000933 0,000394 391 0,000172 0,000394 293 1,000000 0,788659 344 0,000394 <td< td=""><td>281</td><td>1,000000</td><td>0,025368</td><td>331</td><td>0,001365</td><td>0,001590</td><td></td><td>381</td><td>0,000243</td><td>0,000394</td></td<>	281	1,000000	0,025368	331	0,001365	0,001590		381	0,000243	0,000394
284 1,000000 0,057388 334 0,001230 0,000964 384 0,000219 0,000394 285 1,000000 0,129670 336 0,001148 0,000688 386 0,000204 0,000394 287 1,00000 0,183618 337 0,001109 0,000589 387 0,000197 0,000394 288 1,00000 0,250586 338 0,001072 0,000510 388 0,000191 0,000394 289 1,000000 0,330048 339 0,001035 0,000446 389 0,000184 0,000394 290 1,000000 0,514138 341 0,000966 0,000394 390 0,000178 0,000394 292 1,000000 0,763140 343 0,000902 0,000394 391 0,000166 0,000394 294 1,000000 0,78659 344 0,000871 0,000394 393 0,000160 0,000394 296 1,000000 0,958965 346 0,000813 0,	282	1,000000	0,030166	332	0,001318	0,001333	ħ	382	0,000234	0,000394
285 1,000000 0,088044 335 0,001189 0,000810 385 0,000211 0,000394 286 1,000000 0,129670 336 0,001148 0,000688 386 0,000204 0,000394 287 1,000000 0,183618 337 0,001109 0,000589 387 0,000197 0,000394 288 1,00000 0,330048 339 0,001035 0,000446 389 0,000184 0,000394 290 1,000000 0,420338 340 0,001000 0,000394 390 0,000178 0,000394 291 1,000000 0,514138 341 0,000966 0,000394 391 0,000172 0,000394 292 1,000000 0,609954 342 0,000933 0,000394 392 0,000166 0,000394 293 1,000000 0,788659 344 0,000871 0,000394 393 0,000160 0,000394 295 1,000000 0,919650 346 0,000813	283	1,000000	0,035871	333	0,001274	0,001129		383	0,000226	0,000394
286 1,000000 0,129670 287 1,000000 0,183618 288 1,000000 0,250586 289 1,000000 0,330048 290 1,000000 0,420338 291 1,000000 0,514138 292 1,000000 0,609954 293 1,000000 0,703140 294 1,000000 0,788659 294 1,000000 0,788659 295 1,000000 0,861948 296 1,000000 0,958965 297 1,000000 0,958965 298 1,000000 0,988917 299 0,805378 1,000000 3449 0,000759 0,000394 399 0,000130 0,000394 399 0,000160 0,000394 391 0,000172 0,000394 392 0,000166 0,000394 393 0,000166 0,000394 393 0,000155 0,000394 394	284	1,000000	0,057388	334	0,001230	0,000964	Ī	384	0,000219	0,000394
287 1,000000 0,183618 337 0,001109 0,000589 387 0,000197 0,000394 288 1,000000 0,250586 338 0,001072 0,000510 388 0,000191 0,000394 289 1,000000 0,330048 339 0,001035 0,000446 389 0,000184 0,000394 290 1,00000 0,514138 341 0,000966 0,000394 390 0,000172 0,000394 292 1,00000 0,609954 342 0,000933 0,000394 392 0,000166 0,000394 293 1,00000 0,788659 344 0,000871 0,000394 393 0,000160 0,000394 294 1,00000 0,861948 345 0,000841 0,000394 395 0,000155 0,000394 296 1,000000 0,958965 347 0,000785 0,000394 396 0,000145 0,000394 298 1,000000 0,988917 348 0,000759 0,0	285	1,000000	0,088044	335	0,001189	0,000810		385	0,000211	0,000394
288 1,000000 0,250586 338 0,001072 0,000510 388 0,000191 0,000394 289 1,000000 0,330048 339 0,001035 0,000446 389 0,000184 0,000394 290 1,000000 0,420338 340 0,001000 0,000394 390 0,000178 0,000394 291 1,000000 0,514138 341 0,000966 0,000394 391 0,000172 0,000394 292 1,000000 0,609954 342 0,000933 0,000394 392 0,000166 0,000394 293 1,000000 0,788659 344 0,000871 0,000394 393 0,000160 0,000394 295 1,000000 0,861948 345 0,000841 0,000394 395 0,000155 0,000394 296 1,000000 0,958965 347 0,000755 0,000394 397 0,000140 0,000394 298 1,000000 0,988917 348 0,000759 <td< td=""><td>286</td><td>1,000000</td><td>0,129670</td><td>336</td><td>0,001148</td><td>0,000688</td><td></td><td>386</td><td>0,000204</td><td>0,000394</td></td<>	286	1,000000	0,129670	336	0,001148	0,000688		386	0,000204	0,000394
289 1,000000 0,330048 339 0,001035 0,000446 389 0,000184 0,000394 290 1,000000 0,420338 340 0,001000 0,000394 390 0,000178 0,000394 291 1,000000 0,514138 341 0,000966 0,000394 391 0,000172 0,000394 292 1,00000 0,609954 342 0,000933 0,000394 392 0,000166 0,000394 293 1,000000 0,788659 344 0,000871 0,000394 393 0,000160 0,000394 295 1,000000 0,861948 345 0,000841 0,000394 395 0,000155 0,000394 296 1,000000 0,958965 347 0,000785 0,000394 397 0,000140 0,000394 298 1,000000 0,988917 348 0,000759 0,000394 399 0,000135 0,000394 299 0,805378 1,000000 349 0,000733	287	1,000000	0,183618	337	0,001109	0,000589	Ī	387	0,000197	0,000394
290 1,000000 0,420338 340 0,001000 0,000394 390 0,000178 0,000394 291 1,000000 0,514138 341 0,000966 0,000394 391 0,000172 0,000394 292 1,000000 0,609954 342 0,000933 0,000394 392 0,000166 0,000394 293 1,000000 0,788659 344 0,000871 0,000394 393 0,000160 0,000394 295 1,000000 0,861948 345 0,000841 0,000394 395 0,000155 0,000394 296 1,000000 0,919650 346 0,000813 0,000394 396 0,000145 0,000394 297 1,000000 0,958965 347 0,000755 0,000394 398 0,000135 0,000394 298 1,000000 0,988917 348 0,000759 0,000394 399 0,000130 0,000394 299 0,805378 1,000000 349 0,000733 <td< td=""><td>288</td><td>1,000000</td><td>0,250586</td><td>338</td><td>0,001072</td><td>0,000510</td><td></td><td>388</td><td>0,000191</td><td>0,000394</td></td<>	288	1,000000	0,250586	338	0,001072	0,000510		388	0,000191	0,000394
291 1,000000 0,514138 341 0,000966 0,000394 391 0,000172 0,000394 292 1,000000 0,609954 342 0,000933 0,000394 392 0,000166 0,000394 293 1,000000 0,788659 343 0,000902 0,000394 393 0,000160 0,000394 294 1,000000 0,788659 344 0,000871 0,000394 394 0,000155 0,000394 295 1,000000 0,861948 345 0,000841 0,000394 395 0,000150 0,000394 296 1,000000 0,919650 346 0,000813 0,000394 396 0,000145 0,000394 297 1,000000 0,988917 348 0,000759 0,000394 398 0,000135 0,000394 298 1,000000 0,988917 348 0,000759 0,000394 399 0,000130 0,000394 299 0,805378 1,000000 349 0,000733 <td< td=""><td>289</td><td>1,000000</td><td>0,330048</td><td>339</td><td>0,001035</td><td>0,000446</td><td>Ī</td><td>389</td><td>0,000184</td><td>0,000394</td></td<>	289	1,000000	0,330048	339	0,001035	0,000446	Ī	389	0,000184	0,000394
292 1,000000 0,609954 342 0,000933 0,000394 392 0,000166 0,000394 293 1,000000 0,703140 343 0,000902 0,000394 393 0,000160 0,000394 294 1,000000 0,788659 344 0,000871 0,000394 394 0,000155 0,000394 295 1,000000 0,861948 345 0,000841 0,000394 395 0,000150 0,000394 296 1,000000 0,919650 346 0,000813 0,000394 396 0,000145 0,000394 297 1,000000 0,988917 348 0,000759 0,000394 397 0,000140 0,000394 298 1,000000 0,988917 348 0,000759 0,000394 398 0,000135 0,000394 299 0,805378 1,000000 349 0,000733 0,000394 399 0,000130 0,000394	290	1,000000	0,420338	340	0,001000	0,000394		390	0,000178	0,000394
293 1,000000 0,703140 343 0,000902 0,000394 393 0,000160 0,000394 294 1,000000 0,788659 344 0,000871 0,000394 394 0,000155 0,000394 295 1,000000 0,861948 345 0,000841 0,000394 395 0,000150 0,000394 296 1,000000 0,919650 346 0,000813 0,000394 396 0,000145 0,000394 297 1,000000 0,988917 348 0,000759 0,000394 397 0,000140 0,000394 298 1,000000 0,988917 348 0,000759 0,000394 398 0,000135 0,000394 299 0,805378 1,000000 349 0,000733 0,000394 399 0,000130 0,000394	291	1,000000	0,514138	341	0,000966	0,000394	Γ	391	0,000172	0,000394
294 1,000000 0,788659 344 0,000871 0,000394 394 0,000155 0,000394 295 1,000000 0,861948 345 0,000841 0,000394 395 0,000150 0,000394 296 1,000000 0,919650 346 0,000813 0,000394 396 0,000145 0,000394 297 1,000000 0,988965 347 0,000785 0,000394 397 0,000140 0,000394 298 1,000000 0,988917 348 0,000759 0,000394 398 0,000135 0,000394 299 0,805378 1,000000 349 0,000733 0,000394 399 0,000130 0,000394	292	1,000000	0,609954	342	0,000933	0,000394	Ī	392	0,000166	0,000394
295 1,000000 0,861948 296 1,000000 0,919650 297 1,000000 0,958965 298 1,000000 0,988917 299 0,805378 1,000000 345 0,000841 0,000394 346 0,000813 0,000394 347 0,000785 0,000394 348 0,000759 0,000394 349 0,000733 0,000394 399 0,000130 0,000394 399 0,000130 0,000394	293	1,000000	0,703140	343	0,000902	0,000394		393	0,000160	0,000394
296 1,000000 0,919650 297 1,000000 0,958965 298 1,000000 0,988917 299 0,805378 1,000000 346 0,000785 0,000394 396 0,000145 0,000394 397 0,000140 0,000394 398 0,000135 0,000394 399 0,000130 0,000394 399 0,000130 0,000394	294	1,000000	0,788659	344	0,000871	0,000394		394	0,000155	0,000394
297 1,000000 0,958965 347 0,000785 0,000394 397 0,000140 0,000394 298 1,000000 0,988917 348 0,000759 0,000394 398 0,000135 0,000394 299 0,805378 1,000000 349 0,000733 0,000394 399 0,000130 0,000394	295	1,000000	0,861948	345	0,000841	0,000394		395	0,000150	0,000394
298 1,000000 0,988917 299 0,805378 1,000000 349 0,000733 0,000394 399 0,000130 0,000394 399 0,000130 0,000394	296	1,000000	0,919650	346	0,000813	0,000394		396	0,000145	0,000394
299 0,805378 1,000000 349 0,000733 0,000394 399 0,000130 0,000394	297	1,000000	0,958965	347	0,000785	0,000394		397	0,000140	0,000394
	298	1,000000	0,988917	348	0,000759	0,000394	Γ	398	0,000135	0,000394
400 0,000126 0,000394	299	0,805378	1,000000	349	0,000733	0,000394		399	0,000130	0,000394
								400	0,000126	0,000394

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	Year	<u>Title</u>	EN/HD	<u>Year</u>
IEC 60050-845	1987	International Electrotechnical Vocabulary (IEV) - Chapter 845: Lighting	-	-
IEC 60081	_1)	Double-capped fluorescent lamps - Performance specifications	EN 60081	1998 ²⁾
IEC 60335-2-27	_1)	Household and similar electrical appliances - Safety - Part 2-27: Particular requirements for appliances for skin exposure to ultraviolet and infrared radiation	EN 60335-2-27	2003 ²⁾
IEC 60901	_1)	Single-capped fluorescent lamps - Performance specifications	EN 60901	1996 ²⁾
IEC 62471	_1)	Photobiological safety of lamps and lamp systems	-	-
CIE 63	1984	The spectroradiometric measurement of light sources	-	-

¹⁾ Undated reference.

²⁾ Valid edition at date of issue.

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