



Test Report issued under the responsibility of:
PL-3 - PREDOM DIVISION

TEST REPORT
IEC 62471
Photobiological safety of lamps and lamp systems

Report Reference No. : Z7-3/184/B/20

Date of issue..... : 11.12.2020

Total number of pages : 24

Name of Testing Laboratory preparing the Report : Łukasiewicz- IMiF PREDOM Division
02-255 Warszawa, ul. Krakowiaków 53, Poland

Applicant's name : LUG LIGHT FACTORY SP. Z O.O.

Address..... : 65-127 Zielona Góra, ul. Gorzowska 11, Poland

Test specification:

Standard : IEC 62471:2006

Test procedure..... : CB

Non-standard test method..... : N/A

Test Report Form No. : IEC62471B

TRF Originator..... : VDE Testing and Certification Institute

Master TRF : Dated 2018-08-16

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Test item description	Fixed general purpose luminaires	
Trade Mark	LUG	
Manufacturer	LUG LIGHT FACTORY SP. Z O.O. 65-127 Zielona Góra, ul. Gorzowska 11, Poland	
Model/Type reference	URBINO ... family cl. I/II	
Ratings	220-240V, 50/60Hz, IP66	
Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):		
<input checked="" type="checkbox"/>	CB Testing Laboratory:	Łukasiewicz- IMiF PREDOM Division
Testing location/ address		02-255 Warszawa, ul. Krakowiaków 53, Poland
Tested by (name, function, signature)		B. Stankiewicz 
Approved by (name, function, signature) ..		T. Małyska 
Supervised by (name, function, signature) :		A. Piotrowski 
<input type="checkbox"/>	Testing procedure: CTF Stage 1:	
Testing location/ address		
Tested by (name, function, signature)		
Approved by (name, function, signature) ..		
<input type="checkbox"/>	Testing procedure: CTF Stage 2:	
Testing location/ address		
Tested by (name + signature)		
Witnessed by (name, function, signature) . :		
Approved by (name, function, signature) ..		
<input type="checkbox"/>	Testing procedure: CTF Stage 3:	
<input type="checkbox"/>	Testing procedure: CTF Stage 4:	
Testing location/ address		
Tested by (name, function, signature)		
Witnessed by (name, function, signature) . :		
Approved by (name, function, signature) ..		
Supervised by (name, function, signature) :		

List of Attachments (including a total number of pages in each attachment): See Attachment No.1 to this test report (Report No. Z7-3/184/B/1/20) – 3 pages	
Summary of testing: Positive	
Tests performed (name of test and test clause): IEC 62471:2006	Testing location: Łukasiewicz- IMiF PREDOM Division 02-255 Warszawa, ul. Krakowiaków 53, Poland
Summary of compliance with National Differences (List of countries addressed): See Attachment No.1 to this test report (Report No. Z7-3/184/B/1/20) <input checked="" type="checkbox"/> The product fulfils the requirements of EN 62471:2008.	

Copy of marking plate:



Test item particulars	Fixed general purpose luminaires	
Tested lamp	<input checked="" type="checkbox"/> continuous wave lamps	<input type="checkbox"/> pulsed lamps
Tested lamp system	URBINO PLUS ... family cl. I/II	
Lamp classification group	<input checked="" type="checkbox"/> exempt	<input type="checkbox"/> risk 1 <input type="checkbox"/> risk 2 <input type="checkbox"/> risk 3
Lamp cap	N/A	
Bulb	Diode: Cree XPG3, Duris S8	
Rated of the lamp	for both luminaires 205 W, 220-240 V, 50-60Hz, IP66	
Furthermore marking on the lamp.....	N/A	
Seasoning of lamps according IEC standard	IEC 60589-2-3	
Used measurement instrument.....	StellarNet UVN-50, IC2 Integrating cube	
Temperature by measurement.....	25°C	
Information for safety use	N/A	
Possible test case verdicts:		
– test case does not apply to the test object	N/A	
– test object does meet the requirement	P (Pass)	
– test object does not meet the requirement	F (Fail)	
Testing:		
Date of receipt of test item	25.11.2020	
Date (s) of performance of tests	25.11.2020 – 10.12.2020	
General remarks:		
"(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report.		
Throughout this report a <input checked="" type="checkbox"/> comma / <input type="checkbox"/> point is used as the decimal separator.		
Manufacturer's Declaration per sub-clause 4.2.5 of IEC60529:		
The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> Not applicable	
When differences exist; they shall be identified in the General product information section.		
Name and address of factory (ies).....	LUG LIGHT FACTORY SP. Z O.O. 65-127 Zielona Góra, ul. Gorzowska 11, Poland	

General product information and other remarks:**Choice sheet of the luminaires URBINO LED cl. I - series:****Example of symbol:**

1302223LR7B40S3600.138.N.P



Designations used on the marking of luminaries (some designation may not appear in the name) :

- | | |
|-----------------|--|
| 1. 13022 | - Code of the series (URBINO) |
| 2. 2 | - Color:
2: grey
5: graphite
0: another |
| 3. 3L | - Type of power supply:
2L - DIMM 1-10V
3L – DALI
5L – on-off
6L – on-off / DALI
7L/PL – programmable |
| 4. R7 | - CRI:
R7 = 70-79
R8 = 80-89 |
| 5. B40 | - Color temperature:
B22 = 2200
B27 = 2700
B30 = 3000
B40 = 4000 |
| 6. S3600 | - Max. luminous flux (e.g. S3600 = 36000lm) |
| 7. 1 | - Safety Class I |
| 8. 38 | - Optic:
01 O2 - for expressways
02 O3 - for municipal roads
03 O4 - for city roads
04 O5 - for residential roads
05 O6P - for pedestrian crossings, right-hand traffic
09 O6L - for pedestrian crossings, left-hand traffic
06 O7 - for area lighting
08 O8 - for city and commune roads
10 O26 - for wet surfaces
12 O33 - for expressways
13 O34 - to municipal roads
14 O35 - for city roads
15 O36 - for residential roads
16 O37P - for pedestrian crossings, right-hand traffic
17 O37L - for pedestrian crossings, left-hand traffic
18 O38 - for area lighting
19 O39 - for city and commune roads
20 O40 - for wet surfaces
30 O13 - for expressways
31 O14 - to municipal roads
32 O15 - for city roads
33 O16 - to residential roads |

35 O59 - for municipal roads
 36 O60 - for city roads
 37 O61 - for residential roads
 38 O62 - for expressways
 39 O63 - for local roads
 40 O64 - for city roads
 41 O65 - for residential roads
 42 O66 - for pedestrian crossings, left-hand traffic
 43 O67 - for pedestrian crossings, right-hand traffic
 44 O68 - for area lighting
 45 O69 - for city and commune roads
 46 O70 - for wet surfaces
 47 O71 - for road lighting
 48 O72 - for road lighting
 49 O73 - for road lighting
 50 O74 - for road lighting
 51 O75 - for road lighting
 52 O76 - for road lighting
 53 O77 - for road lighting
 54 O78 - for road lighting
 55 O79 - for road lighting
 56 O80 - for road lighting
 57 O81 - for road lighting
 58 O82 - for road lighting
 59 O83 - for road lighting
 60 O84 - for road lighting
 61 O85 - for road lighting
 62 O86 - for road lighting
 63 O87 - for road lighting
 64 O89- for road lighting
 65 O90 - for road lighting
 66 O91 - for road lighting
 67 O92 - for road lighting
 68 O93 - for road lighting
 69 O94 - for road lighting
 70 O95 - for road lighting
 71 O96 - for road lighting
 72 O97 - for road lighting
 73 O98 - for road lighting
 74 O99 - for road lighting
 XX OXX – for investment optics

9. N.P

- Additional equipment
- A - additional corrosion protection
- B - Tool-free access to the LED Driver
- U - \varnothing 76mm pole
- N - NEMA Socket
- Z - ZHAGA Socket
- T - NTC Sensor
- W - Twilight Sensor
- V - Surge Device Protector 10kV
- P- Anti pressure vent
- I- iBloc ("URBAN" smart city system)
- K- Knife switch connector

Choice sheet of the luminaires URBINO LED cl. II - series:**Example of symbol:**

130222.3LR7B40S3600.238.N.P

1 2 3 4 5 6 7 8 9

Designations used on the marking of luminaires (some designation may not appear in the name) :

- | | |
|-----------------|---|
| 1. 13022 | - Code of the series (URBINO) |
| 2. 2 | - Color:
2: grey
5: graphite
0: another |
| 3. 3L | - Type of power supply:
2L - DIMM 1-10V
3L – DALI
5L – on-off
6L – on-off / DALI
7L/PL – programmable |
| 4. R7 | - CRI:
R7 = 70-79
R8 = 80-89 |
| 5. B40 | - Color temperature:
B22 = 2200
B27 = 2700
B30 = 3000
B40 = 4000 |
| 6. S3600 | - Max. luminous flux (e.g. S3600 = 36000lm) |
| 7. 2 | - Safety Class II |
| 8. 38 | - Optic:
01 O2 - for expressways
02 O3 - for municipal roads
03 O4 - for city roads
04 O5 - for residential roads
05 O6P - for pedestrian crossings, right-hand traffic
09 O6L - for pedestrian crossings, left-hand traffic
06 O7 - for area lighting
08 O8 - for city and commune roads
10 O26 - for wet surfaces
12 O33 - for expressways
13 O34 - to municipal roads
14 O35 - for city roads
15 O36 - for residential roads
16 O37P - for pedestrian crossings, right-hand traffic
17 O37L - for pedestrian crossings, left-hand traffic
18 O38 - for area lighting
19 O39 - for city and commune roads
20 O40 - for wet surfaces
30 O13 - for expressways |

31 O14 - to municipal roads
 32 O15 - for city roads
 33 O16 - to residential roads
 35 O59 - for municipal roads
 36 O60 - for city roads
 37 O61 - for residential roads
 38 O62 - for expressways
 39 O63 - for local roads
 40 O64 - for city roads
 41 O65 - for residential roads
 42 O66 - for pedestrian crossings, left-hand traffic
 43 O67 - for pedestrian crossings, right-hand traffic
 44 O68 - for area lighting
 45 O69 - for city and commune roads
 46 O70 - for wet surfaces
 47 O71 - for road lighting
 48 O72 - for road lighting
 49 O73 - for road lighting
 50 O74 - for road lighting
 51 O75 - for road lighting
 52 O76 - for road lighting
 53 O77 - for road lighting
 54 O78 - for road lighting
 55 O79 - for road lighting
 56 O80 - for road lighting
 57 O81 - for road lighting
 58 O82 - for road lighting
 59 O83 - for road lighting
 60 O84 - for road lighting
 61 O85 - for road lighting
 62 O86 - for road lighting
 63 O87 - for road lighting
 64 O89- for road lighting
 65 O90 - for road lighting
 66 O91 - for road lighting
 67 O92 - for road lighting
 68 O93 - for road lighting
 69 O94 - for road lighting
 70 O95 - for road lighting
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 74 O99 - for road lighting
 XX OXX – for investment optics

9. N.P

- Additional equipment
 - A - additional corrosion protection
 - B - Tool-free access to the LED Driver
 - U - ϕ 76mm pole
 - N - NEMA Socket
 - Z - ZHAGA Socket
 - T - NTC Sensor
 - W - Twilight Sensor
 - V - Surge Device Protector 10kV
 - P- Anti pressure vent
 - I- iBloc ("URBAN" smart city system)
 - K- Knife switch connector

After review of technical documentation, model series, characteristic of particular models, differences between models, technical parameters, class of luminaires, IP code, light sources, components, etc., luminaire Urbino LED ED 29300lm/730 and Urbino LED ED DALI 27650lm/740 have been tested as representatives of all models of luminaires.

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict
4	EXPOSURE LIMITS		P
4.1	General		P
	The exposure limits in this standard is not less than 0,01 ms and not more than any 8-hour period and should be used as guides in the control of exposure		P
	Detailed spectral data of a light source are generally required only if the luminance of the source exceeds $10^4 \text{ cd}\cdot\text{m}^{-2}$	see clause 4.3	P
4.3	Hazard exposure limits		P
4.3.1	Actinic UV hazard exposure limit for the skin and eye		P
	The exposure limit for effective radiant exposure is $30 \text{ J}\cdot\text{m}^{-2}$ within any 8-hour period		P
	To protect against injury of the eye or skin from ultraviolet radiation exposure produced by a broad-band source, the effective integrated spectral irradiance, E_s , of the light source shall not exceed the levels defined by:		P
	$E_s \cdot t = \sum_{200}^{400} \sum_t E_\lambda(\lambda, t) \cdot S_{UV}(\lambda) \cdot \Delta t \cdot \Delta \lambda \leq 30 \quad \text{J}\cdot\text{m}^{-2}$		P
	The permissible time for exposure to ultraviolet radiation incident upon the unprotected eye or skin shall be computed by:		P
	$t_{\max} = \frac{30}{E_s} \quad \text{s}$		P
4.3.2	Near-UV hazard exposure limit for eye		P
	For the spectral region 315 nm to 400 nm (UV-A) the total radiant exposure to the eye shall not exceed $10000 \text{ J}\cdot\text{m}^{-2}$ for exposure times less than 1000 s. For exposure times greater than 1000 s (approximately 16 minutes) the UV-A irradiance for the unprotected eye, E_{UVA} , shall not exceed $10 \text{ W}\cdot\text{m}^{-2}$.		P
	The permissible time for exposure to ultraviolet radiation incident upon the unprotected eye for time less than 1000 s, shall be computed by:		P
	$t_{\max} \leq \frac{10\,000}{E_{UVA}} \quad \text{s}$		P
4.3.3	Retinal blue light hazard exposure limit		P
	To protect against retinal photochemical injury from chronic blue-light exposure, the integrated spectral radiance of the light source weighted against the blue-light hazard function, $B(\lambda)$, i.e., the blue-light weighted radiance, L_B , shall not exceed the levels defined by:		P
	$L_B \cdot t = \sum_{300}^{700} \sum_t L_\lambda(\lambda, t) \cdot B(\lambda) \cdot \Delta t \cdot \Delta \lambda \leq 10^6 \quad \text{J} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$	for $t \leq 10^4 \text{ s}$ $t_{\max} = \frac{10^6}{L_B}$	P

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Clause	Requirement + Test	Result – Remark	Verdict
	$L_B = \sum_{300}^{700} L_\lambda \cdot B(\lambda) \cdot \Delta\lambda \leq 100 \quad W \cdot m^{-2} \cdot sr^{-1}$	for $t > 10^4$ s	P
4.3.4	Retinal blue light hazard exposure limit - small source		N/A
	Thus the spectral irradiance at the eye E_λ , weighted against the blue-light hazard function $B(\lambda)$ shall not exceed the levels defined by:	see table 4.2	N/A
	$E_B \cdot t = \sum_{300}^{700} \sum_t E_\lambda(\lambda, t) \cdot B(\lambda) \cdot \Delta\lambda \leq 100 \quad J \cdot m^{-2}$	for $t \leq 100$ s	N/A
	$E_B = \sum_{300}^{700} E_\lambda \cdot B(\lambda) \cdot \Delta\lambda \leq 1 \quad W \cdot m^{-2}$	for $t > 100$ s	N/A
4.3.5	Retinal thermal hazard exposure limit		P
	To protect against retinal thermal injury, the integrated spectral radiance of the light source, L_λ , weighted by the burn hazard weighting function $R(\lambda)$ (from Figure 4.2 and Table 4.2), i.e., the burn hazard weighted radiance, shall not exceed the levels defined by:		P
	$L_R = \sum_{380}^{1400} L_\lambda \cdot R(\lambda) \cdot \Delta\lambda \leq \frac{50\,000}{\alpha \cdot t^{0.25}} \quad W \cdot m^{-2} \cdot sr^{-1}$	($10 \mu s \leq t \leq 10$ s)	P
4.3.6	Retinal thermal hazard exposure limit – weak visual stimulus		N/A
	For an infrared heat lamp or any near-infrared source where a weak visual stimulus is inadequate to activate the aversion response, the near infrared (780 nm to 1400 nm) radiance, L_{IR} , as viewed by the eye for exposure times greater than 10 s shall be limited to:		N/A
	$L_{IR} = \sum_{780}^{1400} L_\lambda \cdot R(\lambda) \cdot \Delta\lambda \leq \frac{6\,000}{\alpha} \quad W \cdot m^{-2} \cdot sr^{-1}$	$t > 10$ s	N/A
4.3.7	Infrared radiation hazard exposure limits for the eye		P
	The avoid thermal injury of the cornea and possible delayed effects upon the lens of the eye (cataractogenesis), ocular exposure to infrared radiation, E_{IR} , over the wavelength range 780 nm to 3000 nm, for times less than 1000 s, shall not exceed:		P
	$E_{IR} = \sum_{780}^{3000} E_\lambda \cdot \Delta\lambda \leq 18\,000 \cdot t^{-0.75} \quad W \cdot m^{-2}$	$t \leq 1000$ s	P
	For times greater than 1000 s the limit becomes:		P
	$E_{IR} = \sum_{780}^{3000} E_\lambda \cdot \Delta\lambda \leq 100 \quad W \cdot m^{-2}$	$t > 1000$ s	P
4.3.8	Thermal hazard exposure limit for the skin		P
	Visible and infrared radiant exposure (380 nm to 3000 nm) of the skin shall be limited to:		

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict
	$E_H \cdot t = \sum_{380}^{3000} \sum_t E_\lambda(\lambda, t) \cdot \Delta t \cdot \Delta \lambda \leq 20\,000 \cdot t^{0,25} \quad \text{J} \cdot \text{m}^{-2}$		P
5	MEASUREMENT OF LAMPS AND LAMP SYSTEMS		P
5.1	Measurement conditions		P
	Measurement conditions shall be reported as part of the evaluation against the exposure limits and the assignment of risk classification.		P
5.1.1	Lamp ageing (seasoning)		P
	Seasoning of lamps shall be done as stated in the appropriate IEC lamp standard.		P
5.1.2	Test environment		P
	For specific test conditions, see the appropriate IEC lamp standard or in absence of such standards, the appropriate national standards or manufacturer's recommendations.		P
5.1.3	Extraneous radiation		P
	Careful checks should be made to ensure that extraneous sources of radiation and reflections do not add significantly to the measurement results.		P
5.1.4	Lamp operation		P
	Operation of the test lamp shall be provided in accordance with:		P
	– the appropriate IEC lamp standard, or		N/A
	– the manufacturer's recommendation		P
5.1.5	Lamp system operation		P
	The power source for operation of the test lamp shall be provided in accordance with:		P
	– the appropriate IEC standard, or		N/A
	– the manufacturer's recommendation		P
5.2	Measurement procedure		P
5.2.1	Irradiance measurements		P
	Minimum aperture diameter 7mm.		P
	Maximum aperture diameter 50 mm.		P
	The measurement shall be made in that position of the beam giving the maximum reading.		P
	The measurement instrument is adequate calibrated.		P
5.2.2	Radiance measurements		P
5.2.2.1	Standard method		N/A
	The measurements made with an optical system.		N/A
	The instrument shall be calibrated to read in absolute radiant power per unit receiving area and per unit solid angle to acceptance averaged over the		N/A

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict
	field of view of the instrument.		
5.2.2.2	Alternative method		P
	Alternatively to an imaging radiance set-up, an irradiance measurement set-up with a circular field stop placed at the source can be used to perform radiance measurements.		P
5.2.3	Measurement of source size		P
	The determination of α , the angle subtended by a source, requires the determination of the 50% emission points of the source.		P
5.2.4	Pulse width measurement for pulsed sources		N/A
	The determination of Δt , the nominal pulse duration of a source, requires the determination of the time during which the emission is > 50% of its peak value.		N/A
5.3	Analysis methods		P
5.3.1	Weighting curve interpolations		P
	To standardize interpolated values, use linear interpolation on the log of given values to obtain intermediate points at the wavelength intervals desired.	see table 4.1	P
5.3.2	Calculations		P
	The calculation of source hazard values shall be performed by weighting the spectral scan by the appropriate function and calculating the total weighted energy.		P
5.3.3	Measurement uncertainty		P
	The quality of all measurement results must be quantified by an analysis of the uncertainty.	see Annex C in the norm	P
6	LAMP CLASSIFICATION		P
	For the purposes of this standard it was decided that the values shall be reported as follows:	see table 6.1	P
	– for lamps intended for general lighting service, the hazard values shall be reported as either irradiance or radiance values at a distance which produces an illuminance of 500 lux, but not at a distance less than 200 mm		P
	– for all other light sources, including pulsed lamp sources, the hazard values shall be reported at a distance of 200 mm		P
6.1	Continuous wave lamps		P
6.1.1	Except Group		P
	In the except group are lamps, which does not pose any photobiological hazard. The requirement is met by any lamp that does not pose:		P
	– an actinic ultraviolet hazard (E_s) within 8-hours exposure (30000 s), nor		P

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Clause	Requirement + Test	Result – Remark	Verdict
	– a near-UV hazard (E_{UVA}) within 1000 s, (about 16 min), nor		P
	– a retinal blue-light hazard (L_B) within 10000 s (about 2,8 h), nor		P
	– a retinal thermal hazard (L_R) within 10 s, nor		P
	– an infrared radiation hazard for the eye (E_{IR}) within 1000 s		P
6.1.2	Risk Group 1 (Low-Risk)		N/A
	In this group are lamps, which exceeds the limits for the except group but that does not pose:		N/A
	– an actinic ultraviolet hazard (E_S) within 10000 s, nor		N/A
	– a near ultraviolet hazard (E_{UVA}) within 300 s, nor		N/A
	– a retinal blue-light hazard (L_B) within 100 s, nor		N/A
	– a retinal thermal hazard (L_R) within 10 s, nor		N/A
	– an infrared radiation hazard for the eye (E_{IR}) within 100 s		N/A
	Lamps that emit infrared radiation without a strong visual stimulus and do not pose a near-infrared retinal hazard (L_{IR}), within 100 s are in Risk Group 1.		N/A
6.1.3	Risk Group 2 (Moderate-Risk)		N/A
	This requirement is met by any lamp that exceeds the limits for Risk Group 1, but that does not pose:		N/A
	– an actinic ultraviolet hazard (E_S) within 1000 s exposure, nor		N/A
	– a near ultraviolet hazard (E_{UVA}) within 100 s, nor		N/A
	– a retinal blue-light hazard (L_B) within 0,25 s (aversion response), nor		N/A
	– a retinal thermal hazard (L_R) within 0,25 s (aversion response), nor		N/A
	– an infrared radiation hazard for the eye (E_{IR}) within 10 s		N/A
	Lamps that emit infrared radiation without a strong visual stimulus and do not pose a near-infrared retinal hazard (L_{IR}), within 10 s are in Risk Group 2.		N/A
6.1.4	Risk Group 3 (High-Risk)		N/A
	Lamps which exceed the limits for Risk Group 2 are in Group 3.		N/A
6.2	Pulsed lamps		N/A
	Pulse lamp criteria shall apply to a single pulse and to any group of pulses within 0,25 s.		N/A
	A pulsed lamp shall be evaluated at the highest nominal energy loading as specified by the manufacturer.		N/A

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict
	The risk group determination of the lamp being tested shall be made as follows:		N/A
	– a lamp that exceeds the exposure limit shall be classified as belonging to Risk Group 3 (High-Risk)		N/A
	– for single pulsed lamps, a lamp whose weighted radiant exposure or weighted radiance does is below the EL shall be classified as belonging to the Exempt Group		N/A
	– for repetitively pulsed lamps, a lamp whose weighted radiant exposure or weighted radiance dose is below the EL, shall be evaluated using the continuous wave risk criteria discussed in clause 6.1, using time averaged values of the pulsed emission		N/A

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict

Table 4.1	Spectral weighting function for assessing ultraviolet hazards for skin and eye			P
Wavelength ¹ λ , nm	UV hazard function $S_{uv}(\lambda)$	Wavelength λ , nm	UV hazard function $S_{uv}(\lambda)$	
200	0,030	313*	0,006	
205	0,051	315	0,003	
210	0,075	316	0,0024	
215	0,095	317	0,0020	
220	0,120	318	0,0016	
225	0,150	319	0,0012	
230	0,190	320	0,0010	
235	0,240	322	0,00067	
240	0,300	323	0,00054	
245	0,360	325	0,00050	
250	0,430	328	0,00044	
254*	0,500	330	0,00041	
255	0,520	333*	0,00037	
260	0,650	335	0,00034	
265	0,810	340	0,00028	
270	1,000	345	0,00024	
275	0,960	350	0,00020	
280*	0,880	355	0,00016	
285	0,770	360	0,00013	
290	0,640	365*	0,00011	
295	0,540	370	0,000093	
297*	0,460	375	0,000077	
300	0,300	380	0,000064	
303*	0,120	385	0,000053	
305	0,060	390	0,000044	
308	0,026	395	0,000036	
310	0,015	400	0,000030	

¹ Wavelengths chosen are representative: other values should be obtained by logarithmic interpolation at intermediate wavelengths.
* Emission lines of a mercury discharge spectrum.

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict

Table 4.2	Spectral weighting functions for assessing retinal hazards from broadband optical sources	P
Wavelength nm	Blue-light hazard function B (λ)	Burn hazard function R (λ)
300	0,01	
305	0,01	
310	0,01	
315	0,01	
320	0,01	
325	0,01	
330	0,01	
335	0,01	
340	0,01	
345	0,01	
350	0,01	
355	0,01	
360	0,01	
365	0,01	
370	0,01	
375	0,01	
380	0,01	0,1
385	0,013	0,13
390	0,025	0,25
395	0,05	0,5
400	0,10	1,0
405	0,20	2,0
410	0,40	4,0
415	0,80	8,0
420	0,90	9,0
425	0,95	9,5
430	0,98	9,8
435	1,00	10,0
440	1,00	10,0
445	0,97	9,7
450	0,94	9,4
455	0,90	9,0
460	0,80	8,0
465	0,70	7,0
470	0,62	6,2
475	0,55	5,5
480	0,45	4,5
485	0,40	4,0
490	0,22	2,2
495	0,16	1,6
500-600	$10^{[(450-\lambda)/50]}$	1,0
600-700	0,001	1,0
700-1050		$10^{[(700-\lambda)/500]}$
1050-1150		0,2
1150-1200		$0,2 \cdot 10^{0,02(1150-\lambda)}$
1200-1400		0,02

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Clause	Requirement + Test	Result – Remark	Verdict

Table 5.4 Summary of the ELs for the surface of the skin or cornea (irradiance based values)						P
Hazard Name	Relevant equation	Wavelength range nm	Exposure duration sec	Limiting aperture rad (deg)	EL in terms of constant irradiance $W \cdot m^{-2}$	
Actinic UV skin & eye	$E_S = \sum E_\lambda \cdot S(\lambda) \cdot \Delta\lambda$	200 – 400	< 30000	1,4 (80)	30/t	
Eye UV-A	$E_{UVA} = \sum E_\lambda \cdot \Delta\lambda$	315 – 400	≤ 1000 > 1000	1,4 (80)	10000/t 10	
Blue-light small source	$E_B = \sum E_\lambda \cdot B(\lambda) \cdot \Delta\lambda$	300 – 700	≤ 100 > 100	< 0,011	100/t 1,0	
Eye IR	$E_{IR} = \sum E_\lambda \cdot \Delta\lambda$	780 – 3000	≤ 1000 > 1000	1,4 (80)	18000/t ^{0,75} 100	
Skin thermal	$E_H = \sum E_\lambda \cdot \Delta\lambda$	380 – 3000	< 10	2π sr	20000/t ^{0,75}	

Table 5.5 Summary of the ELs for the retina (radiance based values)						P
Hazard Name	Relevant equation	Wavelength range nm	Exposure duration sec	Field of view radians	EL in terms of constant radiance $W \cdot m^{-2} \cdot sr^{-1}$	
Blue light	$L_B = \sum L_\lambda \cdot B(\lambda) \cdot \Delta\lambda$	300 – 700	0,25 – 10 10-100 100-10000 ≥ 10000	$0,011 \cdot \sqrt{(t/10)}$ 0,011 $0,0011 \cdot \sqrt{t}$ 0,1	10 ⁶ /t 10 ⁶ /t 10 ⁶ /t 100	
Retinal thermal	$L_R = \sum L_\lambda \cdot R(\lambda) \cdot \Delta\lambda$	380 – 1400	< 0,25 0,25 – 10	0,0017 $0,011 \cdot \sqrt{(t/10)}$	50000/($\alpha \cdot t^{0,25}$) 50000/($\alpha \cdot t^{0,25}$)	
Retinal thermal (weak visual stimulus)	$L_{IR} = \sum L_\lambda \cdot R(\lambda) \cdot \Delta\lambda$	780 – 1400	> 10	0,011	6000/ α	

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Clause	Requirement + Test	Result – Remark	Verdict

Table 6.1		Emission limits for risk groups of continuous wave lamps for URBINO LED ED 29300lm/730								P
Risk	Action spectrum	Symbol	Units	Emission Measurement						
				Exempt		Low risk		Mod risk		
				Limit	Result	Limit	Result	Limit	Result	
Actinic UV	$S_{UV}(\lambda)$	E_s	$W \cdot m^{-2}$	0,001	5,715e-08	0,003	N/A	0,03	N/A	
Near UV		E_{UVA}	$W \cdot m^{-2}$	10	0,000763	33	N/A	100	N/A	
Blue light	$B(\lambda)$	L_B	$W \cdot m^{-2} \cdot sr^{-1}$	100	46,69	10000	N/A	4000000	N/A	
Blue light, small source	$B(\lambda)$	E_B	$W \cdot m^{-2}$	1,0*	N/A	1,0	N/A	400	N/A	
Retinal thermal	$R(\lambda)$	L_R	$W \cdot m^{-2} \cdot sr^{-1}$	$28000/\alpha$	-	$28000/\alpha$	N/A	$71000/\alpha$	N/A	
Retinal thermal, weak visual stimulus**	$R(\lambda)$	L_{IR}	$W \cdot m^{-2} \cdot sr^{-1}$	$6000/\alpha$	-	$6000/\alpha$	N/A	$6000/\alpha$	N/A	
IR radiation, eye		E_{IR}	$W \cdot m^{-2}$	100	0	570	N/A	3200	N/A	

* Small source defined as one with $\alpha < 0,011$ radian. Averaging field of view at 10000 s is 0,1 radian.
** Involves evaluation of non-GLS source

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Clause	Requirement + Test	Result – Remark	Verdict

Table 6.1		Emission limits for risk groups of continuous wave lamps for URBINO LED ED DALI 27650lm/740								P
Risk	Action spectrum	Symbol	Units	Emission Measurement						
				Exempt		Low risk		Mod risk		
				Limit	Result	Limit	Result	Limit	Result	
Actinic UV	$S_{UV}(\lambda)$	E_s	$W \cdot m^{-2}$	0,001	2e-07	0,003	N/A	0,03	N/A	
Near UV		E_{UVA}	$W \cdot m^{-2}$	10	0,001579	33	N/A	100	N/A	
Blue light	$B(\lambda)$	L_B	$W \cdot m^{-2} \cdot sr^{-1}$	100	64,87	10000	N/A	4000000	N/A	
Blue light, small source	$B(\lambda)$	E_B	$W \cdot m^{-2}$	1,0*	N/A	1,0	N/A	400	N/A	
Retinal thermal	$R(\lambda)$	L_R	$W \cdot m^{-2} \cdot sr^{-1}$	$28000/\alpha$	-	$28000/\alpha$	N/A	$71000/\alpha$	N/A	
Retinal thermal, weak visual stimulus**	$R(\lambda)$	L_{IR}	$W \cdot m^{-2} \cdot sr^{-1}$	$6000/\alpha$	-	$6000/\alpha$	N/A	$6000/\alpha$	N/A	
IR radiation, eye		E_{IR}	$W \cdot m^{-2}$	100	0	570	N/A	3200	N/A	

* Small source defined as one with $\alpha < 0,011$ radian. Averaging field of view at 10000s is 0,1 radian.
** Involves evaluation of non-GLS source

List of test equipment used:

A completed list of used test equipment shall be provided in the Test Reports when a Customer's Testing Facility according to CTF stage 1 or CTF stage 2 procedure has been used.

Note: This page may be removed when CTF stage 1 or CTF stage 2 are not used. See also clause 4.8 in OD 2020 for more details.

Clause	Measurement / testing	Testing / measuring equipment / material used, (Equipment ID)	Range used	Last Calibration date	Calibration due date

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