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TEST REPORT

IEC 62471

Photobiological safety of lamps and lamp systems

Customer .....: Address .....: City .....: Country .....:	**BOVER IL.LUMINACIO & MOBILIARI,SL** Avda. de Catalunya, 173 08440 Cardedeu- Barcelona
Sample description [1] .....: Sample code [1] .....: Test date .....: Sample Record .....: Test code .....:	**RODA** 366 23-06-2023 RM23050309 CL092A23B004
Laboratory .....: Address .....: City .....: Country .....:	**ASSELUM LUMINOTECNICS, S.L.** C/ Ca n'Alzina 76 08202 Barcelona Spain
Standard .....:	IEC 62471:2006 EN 62471:2008 UNE EN 62471:2009 IEC/TR 62778: 2014
Test report approved by: Marc Ballbè Head of the laboratory	43564191Y MARC BALLBE (R: B62741152) Firmado digitalmente por43564191Y MARC BALLBE (R: B62741152) DN: cn=43564191Y MARC BALLBE (R: B62741152) gn=MARC c=ES o=ASSELUM LUMINOTECNICS SL Motivo:Apruebo este documento Ubicaci- n: Fecha:2024-01-15 14:41+01:00

Note: [1] *Information supplied by the applicant for the test Asselum is not responsible for this information, nor for the identifying marks included in the sample.*

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The uncertainty of the measurements included in this report are available, upon express request, in the IT15 technical instruction of ***ASSELUM luminotécnics, S.L.*** *.*

Test item particulars:

Tested lamp system .....:	Fuente de luz continua
Correlated Color Temperature (CCT):	K
Lamp classification group.....:	Exempt group (Risk 0)
Bulb/Source.....:	LED
Used measurement instrument.....:	Spectroradiometer 230nm-1000nm
Temperature by measurement (**ºC**).....:	25
Power supply .....:	24 V [DC]
Measurement distance (**mm**).....:	460

Sample image:



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)**

General remarks:
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This report consists of 12 pages and following appendixes.

IEC 62471			
Clause	**Requirement + Test**	**Result - Remark**	**Verdict**
4	EXPOSURE LIMITS		P
	Contents of the whole Clause 4 of IEC 62471: 2006 moved into a new informative Annex ZB		P
	Clause 4 replaced by the following:		P
	Limits of the Artificial Optical Radiation Directive(2006/25/EC) have been applied instead of those fixed in IEC 62471: 2006		P
Annex ZB	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 104 cd/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 J.m-2 within any 8-hour period		P
	To protect against injury of the eye or skin from ultraviolet radiation exposure produced by a broadband source, the effective integrated spectral irradiance, Es, of the light source shall not exceed the levels defined by:		P
	$E_s \cdot t = \sum_{200}^{400} \sum_{t} E_\lambda(\lambda,t) \cdot S_{UV}(\lambda) \cdot \Delta t \cdot \Delta\lambda \le 30 \quad J \cdot m^{-2}$		P
	The permissible time for exposure to ultraviolet radiation incident upon the unprotected eye or skin shall be computed by:		P
	tmax=30/Es		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 J.m-2 for exposure times less than 1000s. For exposure times greater than 1000 s (approximately 16 minutes) the UV-A irradiance for the unprotected eye, EUVA, shall not exceed 10 W·m-2	See the Table 6.1	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
	tmax≤ 10000/EUVA s		P

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Clause	**Requirement + Test**	**Result - Remark**	**Verdict**
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(**λ**), i.e., the blue-light weighted radiance , LB, shall not exceed the levels defined by:		P
	$L_B \cdot t = \sum_{300}^{700} \sum_{t} L_\lambda(\lambda,t) \cdot B(\lambda) \cdot \Delta t \cdot \Delta\lambda \le 10^6 \quad J \cdot m^{-2} sr^{-1}$	for t ≤ 10^4 s $t_{máx.} = \frac{10^6}{L_B}$ s	P
	$L_B = \sum_{300}^{700} L_\lambda \cdot B(\lambda) \cdot \Delta\lambda \le 100 \quad W \cdot m^{-2} \cdot sr^{-1}$	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_, weighted against the blue-light hazard function B(**λ**) shall not exceed the levels defined by: see table 4.2	see table 4.2	N/A
	$E_B \cdot t = \sum_{300}^{700} \sum_{t} E_\lambda(\lambda,t) \cdot B(\lambda) \cdot \Delta t \cdot \Delta\lambda \le 100 \quad J \cdot m^{-2}$	for t ≤ 100 s	N/A
	$E_B = \sum_{300}^{700} E_\lambda \cdot B(\lambda) \cdot \Delta\lambda \le 1 \quad W \cdot m^{-2}$	for t > 100 s	N/A

IEC 62471			
Clause	**Requirement + Test**	**Result - Remark**	**Verdict**
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)		N/A
	Seasoning of lamps shall be done as stated in the Appropriate EN lamp standard.		N/A
5.1.2	Test environment		P
	For specific test conditions, see the appropriate EN 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		N/A
	Operation of the test lamp shall be provided in accordance with:		N/A
	– the appropriate EN lamp standard, or		N/A
	– the manufacturer' s recommendation		P
5.1.5	Lamp system operation		N/A
	The power source for operation of the test lamp shall be provided in accordance with:		N/A
	– the appropriate EN 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 field of view of the instrument.		N/A
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 △t, 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

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Clause	**Requirement + Test**	**Result - Remark**	**Verdict**
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		N/A
6.1	Continuous wave lamps		
6.1.1	Exempt 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 (ES) within 8-hours exposure (30000 s), nor		P
	– a near-UV hazard (EUVA) within 1000 s, (about 16 min), nor		P
	– a retinal blue-light hazard (LB) within 10000 s (about 2,8 h), nor		P
	– a retinal thermal hazard (LR) within 10 s, nor		N/A
	– an infrared radiation hazard for the eye (EIR) within 1000s		N/A
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 (ES) within 10000 s, nor		N/A
	– a near ultraviolet hazard (EUVA) within 300 s, nor		N/A
	– a retinal blue-light hazard (LB) within 100 s, nor		N/A
	– a retinal thermal hazard (LR) within 10 s, nor		N/A
	– an infrared radiation hazard for the eye (EIR) within 100 s		N/A
	Lamps that emit infrared radiation without a strong visual stimulus and do not pose a near-infrared retinal hazard (LIR), within 100 s are in Risk Group 1.		N/A

IEC 62471			
Clause	**Requirement + Test**	**Result - Remark**	**Verdict**
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 (ES) within 1000 s exposure, nor		N/A
	– a near ultraviolet hazard (EUVA) within 100 s, nor		N/A
	– a retinal blue-light hazard (LB) within 0,25 s (aversion response), nor		N/A
	– a retinal thermal hazard (LR) within 0,25 s (aversion response), nor		N/A
	– an infrared radiation hazard for the eye (EIR) within 10 s		N/A
	Lamps that emit infrared radiation without a strong visual stimulus and do not pose a near-infrared retinal hazard (LIR), 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
	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 (HighRisk)		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

Table 4.1 Spectral weighting function for assessing ultraviolet hazards for skin and eye

Wavelength (λ, nm)	UV hazard function SUV(λ)	Wavelength (λ, nm)	UV hazard function SUV(λ)
200	0.030	313 [1]	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 [1]	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 [1]	0.880	355	0.00016
285	0.770	360	0.00013
290	0.640	365 [1]	0.00011
295	0.540	370	0.000093
297	0.460	375	0.000077
300	0.300	380	0.000064
303[1]	0.120	385	0.000053
305	0.060	390	0.000044
308	0.026	395	0.000036
310	0.015	400	0.000030

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

Table 4.2 Spectral weighting functions for assessing retinal hazards from broadband optical sources

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-λ)/50]	1.0
600-700	0.001	1.0
700-1050	0.013	10^[(700-λ)/500]
1050-1150	0.025	0.2
1150-1200	0.05	0.2^100.02(1150-λ)
1200-1400	0.10	0.02

Wavelengths chosen are representative: other values should be obtained by logarithmic interpolationat intermediate wavelengths.

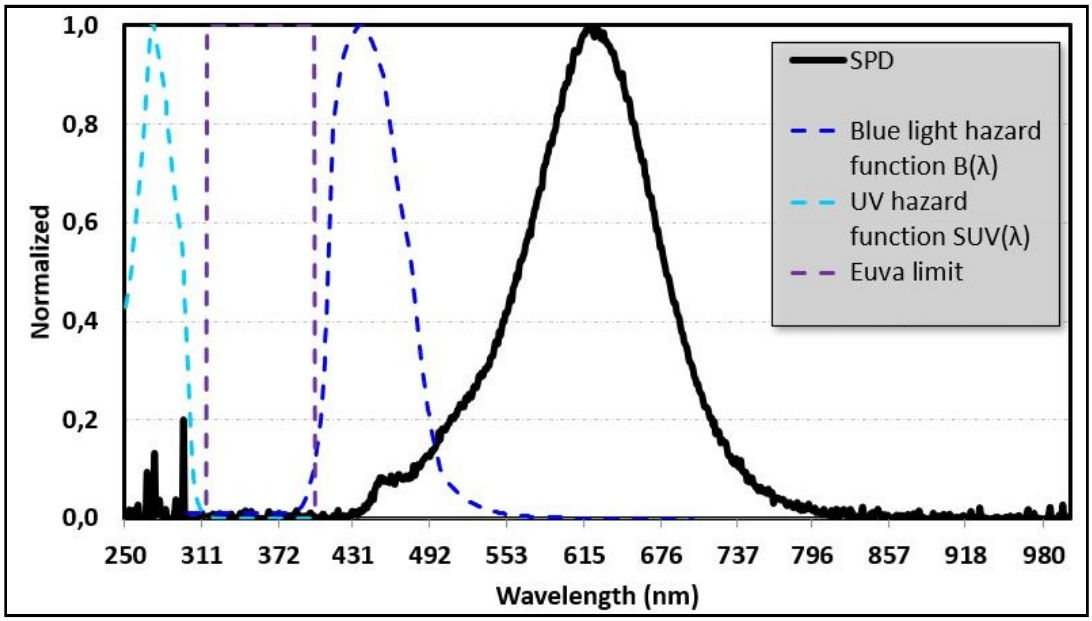
Table 5.4	Summary of the ELs for the surface of the skin or cornea (irradiance based values)				
Hazard Name	**Relevant equation**	**Wavelength range nm**	**Exposure duration sec**	**Limiting aperture rad (deg)**	**EL in terms of constant irradiance $W \cdot m^{-2}$**
Actinic UV skin & eye	$E_S = \sum E_\lambda \cdot S(\lambda) \cdot \Delta\lambda$	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)				
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

Table 6.1 Emission limits for risk groups of continuous wave lamps base on Directive(2006/25/EC)				
Risk	**Action spectrum**	Field of view (mrad)	**Emission limits**	**Measurements**
Irradiance measurement (**w/m^2**)				
***Actinic UV**	*SUV(λ)*	-	0,001	9,13E-04
		-	0,003	-
		-	0,03	-
Near UV		-	10	4,45E-04
		-	33	-
		-	100	-
Blue light small source #	*B(λ)*	-	1	N/A
		-	1	N/A
		-	400	N/A
Radiance measurements (**w/m^2/sr**)				
Blue light	*B(λ)*	100	100	5,76E+00
		11	10.000	-
		1,7	400.000	-

 # Small source defined as one withα< 0,011 radian. Averaging field of view at 10000 s is 0,1 radian

Spectral distribution



Lamp classification group	**Exempt group (Risk 0)**

***General product information:**

The results obtained in this report refer only to the sample tested in accordance with section 'Test item particulars'