






TEST REPORT IEC 62471 Photobiological safety of lamps and lamp systems	
Report Reference No.	381735TRFPHO
Date of issue	2019/10/03
Total number of pages	25
Name of Testing Laboratory preparing the Report	Nemko Spa Via del Carroccio, 4 - 20853 Biassono (MB) – ITALY
Applicant's name	CLuce Srl
Address	Via Marmolada, 5/11 – 20060 – Trucazzano (MI) - Italy
Test specification:	
Standard	IEC 62471:2006
Test procedure	Testing
Non-standard test method	N/A
Test Report Form No.	IEC62471
TRF Originator	Nemko Spa
Master TRF	Dated 2019-09
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Test item description	LED light	
Trade Mark.....	 CLuce ()	
Manufacturer	Cluce Srl Via Marmolada, 5/11 – 20060 – Trucazzano (MI) - Italy	
Model/Type reference.....	ANTARES 244643.936 (see speaking code on pag. 5)	
Ratings.....	315 W 220-240 V 50-60 Hz 4000 K Cl. II	
Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):		
<input checked="" type="checkbox"/>	Testing Laboratory:	
Testing location/ address	Nemko Spa, Via del Carroccio, 4 – Biassono (MB) – Italy	
Tested by (name, function, signature)	Oscar Segantin (Project Handler)	
Approved by (name, function, signature) ..	Roberto Giampaglia (Verifier)	
<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) :		

<p>List of Attachments (including a total number of pages in each attachment):</p> <ul style="list-style-type: none"> - Attachment 1: Best Measurement Capability (1 page) - Attachment 2: European group differences and national differences (2 pages) - Attachment 3: Labelling requirements of IEC/TR 62471-2 (2 pages) - Attachment 4: Characteristics of lamps (1 page) - Attachment 5: Photo documentation (2 pages) - Attachment 6: Equipment used for testing (1 page) 	
<p>Summary of testing:</p> <p>The EuT is a LED streetlight with 36 LEDs. According to the standard, it has been considered as a general lighting service (GLS).</p> <ul style="list-style-type: none"> - The radiation measures are carried out at the distance of 500 lx as requested by the standard 	
<p>Tests performed (name of test and test clause):</p> <p>Cl. 4- Exposure Limits Cl. 5- Measurement of lamp and lamp system Cl. 6- Lamp classification</p> <p>Note: The following Nemko technical procedures were also applied during testing:</p> <ul style="list-style-type: none"> - WML0177 General routines for using instruments at Nemko. - WML1002: Measurement Uncertainty – Policy and Statement. - WML0066: Procedure for measurement of Photobiological safety of lamps and lamp systems <p>Statement of the measurement uncertainty: See Attachment 1 for best measurement capability</p> <p>Unless different values are declared in the test case, following ambient conditions apply for the tests:</p> <ul style="list-style-type: none"> - Ambient temperature 18÷33 °C - Relative Humidity 30÷70 % - Atmospheric Pressure 980÷1020 hPa <p>Equipment used for testing is recorded and saved into Attachment 6 to this test report.</p>	<p>Testing location:</p> <p>Nemko Spa Via del Carroccio, 4 – 20853 Biassono (MB) –Italy (for all tests)</p>
<p>Summary of compliance with National Differences (List of countries addressed):</p> <ul style="list-style-type: none"> - European Countries <p><input checked="" type="checkbox"/> The product fulfils the requirements of:</p> <ul style="list-style-type: none"> - EN 62471:2008 	

Copy of marking plate:

The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.



<p>Calibration</p>	<p>All instruments used in the tests given in this test report are calibrated and traceable to national or international standards. Further information about traceability will be given on request.</p>
<p>Measurement uncertainty</p>	<p>Measurement uncertainties are calculated for all instruments and instrument set-ups given in this report. Calculations are based on the principles given in the standard EA-4/02 (Dec. 1999), IEC Guide 115:2007 and Nemko technical procedure WML1002. Further information about measurement uncertainties will be given on request.</p>
<p>Evaluation of results</p>	<p>If not explicitly stated otherwise in the standard, the test is passed if the measured value is equal to or below (above) the limit line, regardless of the measurement uncertainty. If the measured value is above (below) the limit line, the test is not passed - ref IEC Guide 115:2007, and Nemko technical procedure WML0177. The instrumentation accuracy is within limits agreed by IECCE-CTL (ref. Nemko technical procedure WML1002).</p>

Test item particulars	LED light		
Tested lamp	<input checked="" type="checkbox"/> continuous wave lamps	<input type="checkbox"/> pulsed lamps	
Tested lamp system	LEDs		
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	--		
Bulb	--		
Rated of the lamp	Refer to first page of this test report		
Furthermore marking on the lamp	--		
Seasoning of lamps according IEC standard	--		
Used measurement instrument.....	Monochromator with its optical accessories. See also Attachment 5.		
Temperature by measurement	26 °C		
Information for safety use.....	None		
Possible test case verdicts:			
– test case does not apply to the test object : N/A (not applicable)			
– test object does meet the requirement : P (Pass)			
– test object does not meet the requirement : F (Fail)			
Testing:			
Date of receipt of test item			
: 2019-10-01			
Date (s) of performance of tests			
: 2019-10-02			
General remarks:			
"(See Enclosure #)" refers to additional information appended to the report.			
"(See appended table)" refers to a table appended to the report.			
The phase of sampling/collection is carried out by manufacturer.			
Throughout this report a <input checked="" type="checkbox"/> comma / <input type="checkbox"/> point is used as the decimal separator.			
General product information and other remarks:			
The equipment under test is a LED light for general purpose composed by 36 LED modules (144 LEDs to- tally) manufactured by SAMSUNG model LH181B, with asymmetric lens with beam angle 50° (characteris- tics of LED are described to attachment 4). Equipment has been supplied by controlgear model Xi FP 330W 2:0.2-0.75A SMDAE 230V C240 sXt manufactured by PHILIPS with ratings:			
Input: 356 W 202-254 V 47-63 Hz 1,77 Amax			
Output: 165 W per channel 350 VdC _{max}			
S/n: 381735 "1/1 identified by Nemko"			
This test report extend the following family:			
- ANTARES 24A643.ZZZ			
Where "A" : characteristics of lens mounted on LED:			
-3: SM symmetric (without lens)			
-4: AS asymmetric lens			
Where "ZZZ" : power of the fitting:			
-416: 140 W			

-520: 175 W

-624: 210 W

-728: 245 W

-832: 280 W

-936: 315 W

- **SKYLINE 50A643.ZZZ ***

Where "A": characteristics of pole adapter:

-6: diameter 60 mm pole adapter

-7: diameter 42 mm pole adapter

Where "ZZZ": power of the fitting:

-104: 35 W

-208: 70 W

-312: 105 W

-416: 140 W

*SKYLINE version mounted the same LED module of the ANTARES version tested in this report.

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict
4	EXPOSURE LIMITS		
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 broadband 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

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict
	$L_B \cdot t = \sum_{300}^{700} \sum_t L_\lambda(\lambda, t) \cdot B(\lambda) \cdot \Delta\lambda \leq 10^6 \quad \text{J} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$	for $t \leq 10^4$ s $t_{\max} = \frac{10^6}{L_B}$	N/A
	$L_B = \sum_{300}^{700} L_\lambda \cdot B(\lambda) \cdot \Delta\lambda \leq 100 \quad \text{W} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$	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
	$E_B \cdot t = \sum_{300}^{700} \sum_t E_\lambda(\lambda, t) \cdot B(\lambda) \cdot \Delta\lambda \leq 100 \quad \text{J} \cdot \text{m}^{-2}$	for $t \leq 100$ s	N/A
	$E_B = \sum_{300}^{700} E_\lambda \cdot B(\lambda) \cdot \Delta\lambda \leq 1 \quad \text{W} \cdot \text{m}^{-2}$	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
	$L_R = \sum_{380}^{1400} L_\lambda \cdot R(\lambda) \cdot \Delta\lambda \leq \frac{50\,000}{\alpha \cdot t^{0,25}} \quad \text{W} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$	($10 \mu\text{s} \leq t \leq 10$ 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
	$L_{IR} = \sum_{780}^{1400} L_\lambda \cdot R(\lambda) \cdot \Delta\lambda \leq \frac{6\,000}{\alpha} \quad \text{W} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$	$t > 10$ 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
	$E_{IR} = \sum_{780}^{3000} E_\lambda \cdot \Delta\lambda \leq 18\,000 \cdot t^{-0,75} \quad \text{W} \cdot \text{m}^{-2}$	$t \leq 1000$ s	N/A
	For times greater than 1000 s the limit becomes:		P
	$E_{IR} = \sum_{780}^{3000} E_\lambda \cdot \Delta\lambda \leq 100 \quad \text{W} \cdot \text{m}^{-2}$	$t > 1000$ s	P

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict
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:	Refer below:	P
	$E_H \cdot t = \sum_{380}^{3000} \sum_t E_\lambda(\lambda, t) \cdot \Delta t \cdot \Delta \lambda \leq 20\,000 \cdot t^{0,25} \quad \text{J} \cdot \text{m}^{-2}$	Limit value: 3560 W/m ² Measured: 1,5 W/m ²	P
5	MEASUREMENT OF LAMPS AND LAMP SYSTEMS		-
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	Refer below:	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.	Considered.	P
5.1.3	Extraneous radiation	Refer below:	P
	Careful checks should be made to ensure that extraneous sources of radiation and reflections do not add significantly to the measurement results.	Dark room	P
5.1.4	Lamp operation	Refer below:	P
	Operation of the test lamp shall be provided in accordance with:	Refer below:	P
	– the appropriate IEC lamp standard, or		N/A
	– the manufacturer's recommendation		P
5.1.5	Lamp system operation	Refer below:	P
	The power source for operation of the test lamp shall be provided in accordance with:	Refer below:	P
	– the appropriate IEC standard, or		N/A
	– the manufacturer's recommendation		P
5.2	Measurement procedure		P
5.2.1	Irradiance measurements	Refer below:	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

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict
5.2.2	Radiance measurements	Refer below:	P
5.2.2.1	Standard method	Refer below:	P
	The measurements made with an optical system.		P
	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.		P
5.2.2.2	Alternative method	Refer below:	N/A
	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.		N/A
5.2.3	Measurement of source size	Refer below:	P
	The determination of α , the angle subtended by a source, requires the determination of the 50% emission points of the source.	Considered source size (LxH) 280x160 mm. $\alpha = 31,4$ mrad	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	Refer below:	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	Refer below:	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	Refer below:	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		-
	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	500 lx measured at 7 m	P
	– for all other light sources, including pulsed lamp sources, the hazard values shall be reported at		N/A

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict
	a distance of 200 mm		
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
	– 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 reti-		N/A

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict
	nal hazard (L_{IR}), within 10 s are in Risk Group 2.		
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 (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
			N/A

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict

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

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict

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	

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict

Table 6.1		Emission limits for risk groups of continuous wave lamps								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	0,00002	0,003	-	0,03	-	
Near UV		E_{UVA}	$W \cdot m^{-2}$	10	0,0	33	-	100	-	
Blue light	$B(\lambda)$	L_B	$W \cdot m^{-2} \cdot sr^{-1}$	100	31,8	10000	-	4000000	-	
Blue light, small source	$B(\lambda)$	E_B	$W \cdot m^{-2}$	1,0*	-	1,0	-	400	-	
Retinal thermal	$R(\lambda)$	L_R	$W \cdot m^{-2} \cdot sr^{-1}$	$28000/\alpha = 895000$	5650	$28000/\alpha$	-	$71000/\alpha$	-	
Retinal thermal, weak visual stimulus**	$R(\lambda)$	L_{IR}	$W \cdot m^{-2} \cdot sr^{-1}$	$6000/\alpha$	-	$6000/\alpha$	-	$6000/\alpha$	-	
IR radiation, eye		E_{IR}	$W \cdot m^{-2}$	100	0,0	570	-	3200	-	

* 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

ATTACHMENT 1: BEST MEASUREMENT CAPABILITY

Test	Range	Measurement Uncertainty	Note
Radiance Blue light, Retinal thermal, Retinal thermal weak visual stimulus	0 ÷ 0.1 MW/(sr.m ²) 300 ÷ 1400 nm	7.0 %	(1)
	0.1 ÷ 100 MW/(sr.m ²) 300 ÷ 1400 nm	8.0 %	(4)
Luminance	0 ÷ 0.1 Mcd/m ²	7.0 %	(1)
	0.1 ÷ 100 Mcd/m ²	8.0 %	
Irradiance Actinic UV, Near UV, Blue light small source, IR radiation, eye	0 ÷ 0.1 MW/(m ²) 200 ÷ 300 nm	9.2 %	(1) (5)
	0.1 ÷ 100 MW/(m ²) 200 ÷ 300 nm	10.0 %	
	0 ÷ 0.1 MW/(m ²) 300 ÷ 3000 nm	6.4 %	
	0.1 ÷ 100 MW/(m ²) 300 ÷ 3000 nm	7.2 %	
Illuminance	0 ÷ 20 klx	4.0 %	(1)
Spectral Radiance	0 ÷ 0.1 MW/(sr.m ² .nm) 300 ÷ 1400 nm	6.2 %	(1)
	0.1 ÷ 1 MW/(sr.m ² .nm) 300 ÷ 1400 nm	7.0 %	
Spectral Irradiance	0 ÷ 0.1 MW/(m ² .nm) 200 ÷ 300 nm	8.6 %	(1)
	0.1 ÷ 1 MW/(m ² .nm) 200 ÷ 300 nm	9.2 %	
	0-0.1 MW/(m ² .nm) 300 ÷ 3000nm	5.4 %	
	0.1 ÷ 1 MW/(m ² .nm) 300 ÷ 3000 nm	6.4 %	
Radiant power Laser radiation Output power	350 ÷ 400 nm 950 ÷ 3000 nm 30 uW ÷ 30 W	9.0 %	(1), (2), (3)
	400 ÷ 950 nm 50 nW ÷ 3 W	4.6 %	(1), (2), (3)
Radiant energy Laser radiation	350 ÷ 400 nm 950 ÷ 3000 nm 20 uJ ÷ 2 J	9.0 %	(1), (2)
	400 ÷ 950 nm 20 uJ ÷ 2 J	4.6 %	(1), (2)
Wavelength	200 ÷ 3000 nm	4.5 %	(1)
Length in optical measurement	0 ÷ 20 mm	0.5 mm	(1)
	20 ÷ 200 mm	2 mm	
	0.2 ÷ 200 m	0.5 %	

NOTES:

- (1) The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$ which has been derived from the assumed normal probability distribution with infinite degrees of freedom and for a coverage probability of 95 %
- (2) In the standard 60825-1 laser radiation can indicate radiant power or radiant energy
- (3) In the standard 60825-1 the radiant power can be called also output power
- (4) The uncertainty value expressed in W/(m²) is the maximum value between the value measured and the limit stated in the standard (see IEC/EN62471) multiplied to the measurement uncertainty stated in the table
- (5) The uncertainty value expressed in W/(sr.m²) is the maximum value between the value measured and the limit stated in the standard (see IEC/EN62471) multiplied to the measurement uncertainty stated in the table

IEC62471A - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict

ATTACHMENT 2 TO TEST REPORT IEC 62471 EUROPEAN GROUP DIFFERENCES AND NATIONAL DIFFERENCES Photobiological safety of lamps and lamps systems			
Differences according to: EN 62471:2008			
Attachment Form No.: EU_GD_IEC62471			
Attachment Originator: Nemko Spa			
Master Attachment: 2019-09			
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	CENELEC COMMON MODIFICATIONS (EN)		P
4	EXPOSURE LIMITS		P
	Contents of the whole Clause 4 of IEC 62471:2006 moved into a new informative Annex ZB		—
	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	See appended Table 6.1	P
4.1	General		P
	First paragraph deleted		—

Table 6.1		Emission limits and evaluation based on EU Directive 2006/25/EC				P
Risk	Action spectrum	Symbol	Units	Limit ⁽¹⁾	Result ⁽²⁾	
Actinic UV	SUV(λ)	E_s	$W \cdot m^{-2}$	0,00104 ⁽⁵⁾	0,00002	
Near UV		E_{UVA}	$W \cdot m^{-2}$	0,347 ⁽⁵⁾	0,0	
Blue light	$B(\lambda)$	L_B	$W \cdot m^{-2} \cdot sr^{-1}$ s	$L_B = 100$ $t > 10000$ s	L = 31,8 t \geq 0	
				$L_B = 10^6/t$ $t \leq 10000$ s	—	
Blue light, small source ⁽³⁾	$B(\lambda)$	E_B	$W \cdot m^{-2}$ s	$E_B = 0,01$ $t > 10000$ s	—	
				$E_B = 100/t$ $t \leq 10000$ s	—	
Retinal thermal	$R(\lambda)$	L_R	$W \cdot m^{-2} \cdot sr^{-1}$ s	$L_R = 2,8 \cdot 10^4/\alpha$ $t > 10$ s	L = 5650 t \geq 0	
				$L_R = 5 \cdot 10^4/(\alpha \cdot t^{0,25})$ $10 \mu s \leq t \leq 10$ s	—	
				$L_R = 8,89 \cdot 10^5/\alpha$ $t < 10 \mu s$	—	
Retinal thermal, weak visual stimulus ⁽⁴⁾	$R(\lambda)$	L_{IR}	$W \cdot m^{-2} \cdot sr^{-1}$ s	$L_{IR} = 6000/\alpha$ $t > 10$ s	—	
				$L_{IR} = 5 \cdot 10^4/(\alpha \cdot t^{0,25})$ $10 \mu s \leq t \leq 10$ s	—	
				$L_{IR} = 8,89 \cdot 10^5/\alpha$ $t < 10 \mu s$	—	
IR radiation, eye		E_{IR}	$W \cdot m^{-2}$ s	$E_{IR} = 100$ $t > 1000$ s	E = 0,0 t \geq 0	
				$E_{IR} = 18000 \cdot t^{0,75}$ $t \leq 1000$ s	—	

(1) α is expressed in radians.
(2) t is the exposure time of the lamp and is expressed in seconds; if $t \geq 0$ there is no limitation is the exposure.
(3) Small source defined as one with $\alpha < 0,011$ radian. Averaging field of view at 10000 s is 0,1 radian.
(4) Involves evaluation of non-GLS source.
(5) The limits $H_{eff} = 30$ and $H_{UVA} = 10^4$ J·m⁻² are converted in W·m⁻² considering the exposure time of 8 hours.

NOTE The action functions: see Table 4.1 and Table 4.2
The applicable aperture diameters: see 4.2.1
The limitations for the angular subtenses: see 4.2.2
The related measurement condition 5.2.3 and the range of acceptance angles: see Table 5.5.

ATTACHMENT 3 TO TEST REPORT IEC/EN 62471 REQUIREMENT OF IEC/TR 62471-2 Photobiological safety of lamps and lamps systems – Part 2: Guidance on manufacturing requirement relating to non-laser optical radiation safety	
Originator: Nemko S.p.A.	
Date of issue: 2013 – 04	

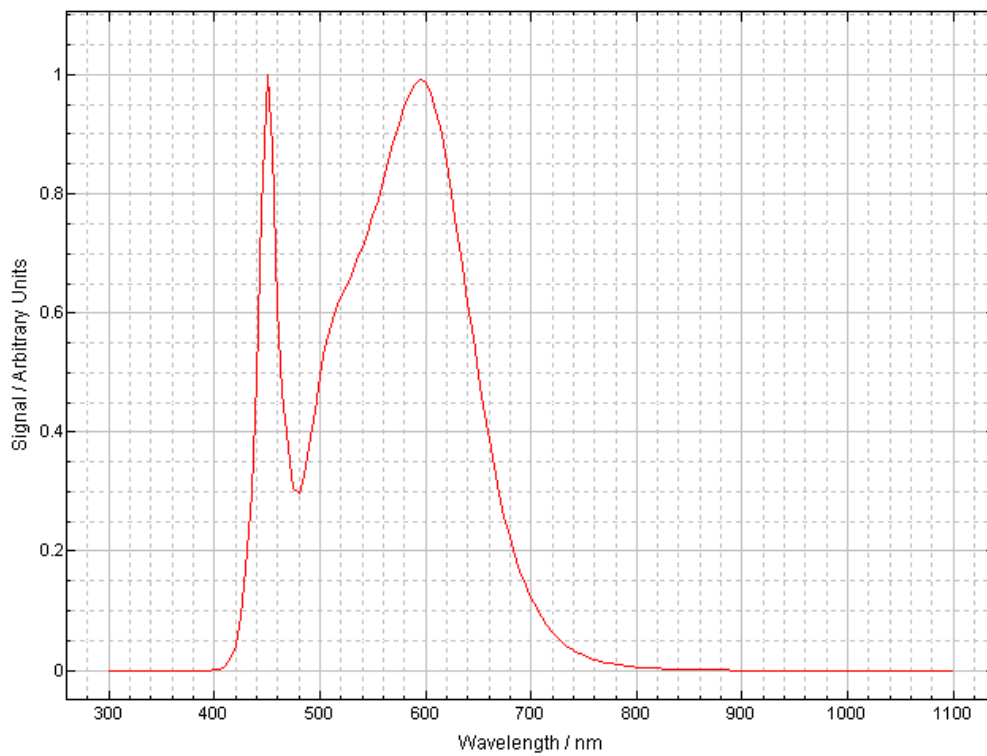
5.4	Labelling required	-
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Table 1	Hazard-related risk group labelling of lamp systems	-		
Hazard	Exempt Risk Group	Risk Group 1	Risk Group 2	Risk Group 3
Ultraviolet hazard 200nm to 400nm	Not required	NOTICE UV emitted from this product	CAUTION UV emitted from this product	WARNING UV emitted from this product
Retinal blue light hazard 300nm to 400nm	Not required	Not required	CAUTION Possibly hazardous optical radiation emitted from this product	WARNING Possibly hazardous optical radiation emitted from this product
Retinal blue light or thermal hazard 400nm to 780nm	Not required	Not required	CAUTION Possibly hazardous optical radiation emitted from this product	WARNING Possibly hazardous optical radiation emitted from this product
Cornea/lens infrared hazard 780nm to 3000nm	Not required	NOTICE IR emitted from this product	CAUTION IR emitted from this product	WARNING IR emitted from this product
Retinal thermal hazard weak visual stimulus 780nm to 1400nm	Not required	WARNING IR emitted from this product	WARNING IR emitted from this product	WARNING IR emitted from this product
Supplementary information: in bold explanation of labelling information and guidance on control measures				

Table 2		Explanation of labelling information and guidance on control measure			-
Hazard	Exempt Risk Group	Risk Group 1	Risk Group 2	Risk Group 3	
Ultraviolet hazard 200nm to 400nm	Not required	Minimise exposure to eyes or skin. Use appropriate shielding.	Eye or skin irritation may result from exposure. Use appropriate shielding.	Avoid eye and skin exposure to unshielded product.	
Retinal blue light hazard 300nm to 400nm	Not required	Not required	Do not stare at operating lamp. May be harmful to the eyes.	Do not look at operating lamp. Eye injury may result.	
Retinal blue light or thermal hazard 400nm to 780nm	Not required	Not required	Do not stare at operating lamp. May be harmful to the eyes.	Do not look at operating lamp. Eye injury may result.	
Cornea/lens infrared hazard 780nm to 3000nm	Not required	Use appropriate shielding or eye protection.	Avoid eye exposure. Use appropriate shielding or eye protection.	Avoid eye exposure. Use appropriate shielding or eye protection.	
Retinal thermal hazard weak visual stimulus 780nm to 1400nm	Not required	Do not stare at operating lamp.	Do not stare at operating lamp.	Do not look at operating lamp.	
Supplementary information: in bold explanation of labelling information and guidance on control measures					

ATTACHMENT 4: CHARACTERISTICS OF LAMP

Application / Function	Manufacturer trademark	Type / Model	Technical data	Standard	Mark(s) of conformity evidence of acceptance
LEDs	SAMSUNG	LH181B	V_F 3,2 V at I_F 1400 mA 4000 K	IEC/EN 62471	Tested in appliance



Spectral measurement normalized

ATTACHMENT 5: PHOTO DOCUMENTATION



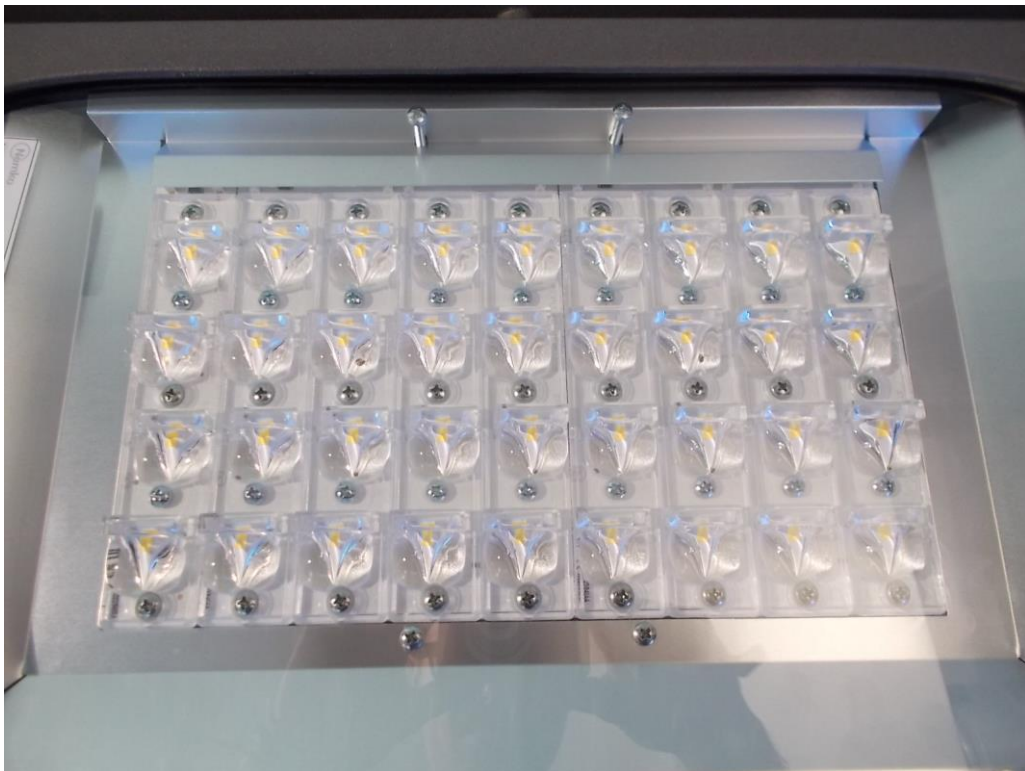
a)



b)



d)



e)

ATTACHMENT 6: EQUIPMENT USED FOR TESTING

MEASUREMENT EQUIPMENT			
Manufacturer	Type of equipment	Type designation	Serial number
Bentham instruments	Double monochromator	IDR300	12290
	Calibration lamp for irradiance measurement	CL6-H	12094/5
	Calibration lamp for irradiance measurements (UV)	CL7	12281/3
	Calibration lamp for radiance measurements	SRS12	12283/3
	Telescope for radiance measurements	TEL309	12280/3
	Illuminance detector	DH400_vl	12284/3
	Power supply	PSU605	12236/4
	Power supply	PSU705	12295
	Diffuser	DIFF_D7	12279/3
	Source Profiler	PSL_Profiler	12698/4
Other instruments	Tape	Stanley 8 m	30-457
	Distance meter	Bosch DLE70	005558860
	Multimeter	Fluke 8846	9673012
	Power supply	Philips	003926
	Data logger	Severis 2	0054634793

-End of Report-