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TEST REPORT IEC 62471

Photobiological safety of lamps and lamp systems

Report Reference No. GZES101200390731

Tested by (name + signature).....: Bica Chen

Approved by (name + signature): Ryan Li

Date of issue: 2010-12-20

Total number of pages: 14 pages

Testing Laboratory: SGS-CSTC Standards Technical Services Co., Ltd. GuangZhou

Branch Testing Center

Address.....: No.198, Kezhu Road, Scientech Park, Guangzhou Economic &

Technology Development District, Guangzhou, Guangdong, CHINA

Applicant's name: EA SRL

Test specification:

Standard: IEC 62471:2006 (First Edition)

Test procedure.....: SGS-CSTC

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

Test Report Form No.: IEC62471A

TRF Originator: VDE Testing and Certification Institute

Master TRF Dated 2009-05

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Test item description.....: High Power LED

Trade Mark....: --

Manufacturer.....: Guangzhou Hongli Opto-electronic Co., Ltd.

West Side of Dongfeng Highway, Auto City, Huadu District,

Guangzhou City, Guangdong, China

Model/Type reference: EF5W1EAF(White)

Ratings.....: 3,0-3,8 Vd.c., 350 mA





Summary of testing:

Due to the physical properties of the Lamp, this product does not contain any radiation above 800nm. Therefore the measured spectral range has been limited from 200nm up to and including 800nm.

The tests were conducted under 350 mA.

Tests performed (name of test and test clause):

These tests fulfil the requirements of standard ISO/IFC 17025

Testing location:

SGS-CSTC Standards Technical Services Co., Ltd. GuangZhou Branch Testing Center

130/1EC 17023.	Guarigation Branch Testing Center
When determining the test conclusion, the Measurement Uncertainty of test has been considered.	No.198, Kezhu Road, Scientech Park, Guangzhou Economic & Technology Development District, Guangzhou, Guangdong, CHINA
Summary of compliance with National Differences	3:
Copy of marking plate:	

SGS

Test item particulars	
Tested lamp	□ continuous wave lamps □ pulsed lamps
Tested lamp system	
Lamp classification group:	exempt risk 1 risk 2 risk 3
Lamp cap:	
Bulb:	
Rated of the lamp	
Furthermore marking on the lamp	
Seasoning of lamps according IEC standard:	
Used measurement instrument:	Ref. to List of test equipment used
Temperature by measurement:	25 ± 5 °C
Information for safety use:	
Possible test case verdicts:	
- test case does not apply to the test object:	N (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	2010-12-08
Date (s) of performance of tests	2010-12-09 – 2010-12-16
General remarks:	
The test results presented in this report relate only to the This report shall not be reproduced, except in full, without "(See Enclosure #)" refers to additional information as "(See appended table)" refers to a table appended to the Throughout this report a comma is used as the decimal List of test equipment must be kept on file and available.	out the written approval of the Issuing testing laboratory. opended to the report. he report. hal separator.
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General product information:	
The product can emit white light when powered.	



IEC 62471						
Clause	Requirement + Test		Result – Remark	Verdict		

Clause	Requirement + Test	Result – Remark	verdict
4	EXPOSURE LIMITS		
4.1	General		Р
	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		Р
	Detailed spectral data of a light source are generally required only if the luminance of the source exceeds $10^4 \mathrm{cd'm^{-2}}$	see clause 4.3	Р
4.3	Hazard exposure limits		Р
4.3.1	Actinic UV hazard exposure limit for the skin and eye		Р
	The exposure limit for effective radiant exposure is 30 J m ⁻² within any 8-hour period		Р
	To protect against injury of the eye or skin from ultraviolet radiation exposure produced by a broadband source, the effective integrated spectral irradiance , $E_{\rm S}$, of the light source shall not exceed the levels defined by:		Р
	$E_{\rm s} \cdot t = \sum_{200}^{400} \sum_t E_{\lambda}(\lambda, t) \cdot S_{\rm UV}(\lambda) \cdot \Delta t \cdot \Delta \lambda \le 30 \qquad \qquad \text{J·m}^{-2}$		Р
	The permissible time for exposure to ultraviolet ra- diation incident upon the unprotected eye or skin shall be computed by:		Р
			Р
4.3.2	Near-UV hazard exposure limit for eye		Р
	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 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 W·m ⁻² .		Р
	The permissible time for exposure to ultraviolet radiation incident upon the unprotected eye for time less than 1000 s, shall be computed by:		Р
	$t_{\text{max}} \le \frac{10\ 000}{E_{\text{UVA}}} \qquad \text{s}$		Р
4.3.3	Retinal blue light hazard exposure limit	•	Р
	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 , L _B , shall not exceed the levels defined by:	see table 4.2	Р



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	$L_{\rm B} \cdot t = \sum_{300}^{700} \sum_{t} L_{\lambda}(\lambda, t) \cdot B(\lambda) \cdot \Delta t \cdot \Delta \lambda \le 10^6 \qquad \text{J} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$	for t ≤ 10 ⁴ s	А		
	$L_{\rm B} = \sum_{300}^{700} L_{\lambda} \cdot B(\lambda) \cdot \Delta \lambda \le 100 \qquad \qquad W \cdot m^{-2} \cdot sr^{-1}$		N		
4.3.4	Retinal blue light hazard exposure limit - small source		Z		
	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:		N		
	$E_{B} \cdot t = \sum_{B} \sum_{B} E_{B}$		Z		
	$E_{B} = \sum_{\lambda}^{700} E_{\lambda} \cdot B(2^{m})$		N		
4.3.5	Retinal thermal hazard exposure limit		Р		
	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:		Р		
	1 <mark>49====================================</mark>	(10 µs ≤ t ≤ 10 s)	Р		
4.3.6	Retinal thermal hazard exposure limit – weak visual s	timulus	N		
	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		
	$L_{IR} = \sum_{k=1}^{1400} L_{\lambda} \cdot R(\lambda) \cdot \Delta \lambda \leq \frac{6000}{4} $		N		
4.3.7	Infrared radiation hazard exposure limits for the eye		N		
	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:		N		
	$E_{\text{IR}} = \sum_{780}^{3000} E_{\lambda} \cdot \Delta \lambda \le 18000 \cdot t^{-0.75}$ W · m ⁻²		N		
	For times greater than 1000 s the limit becomes:		N		





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$$E_{\rm IR} = \sum_{780}^{3\,000} E_{\lambda} \cdot \Delta \lambda \le 100$$
 W · m⁻²



IEC 62471 Clause Requirement + Test Result - Remark Verdict Р The measurement shall be made in that position of the beam giving the maximum reading. Р The measurement instrument is adequate calibrated. 5.2.2 Р Radiance measurements 5.2.2.1 Standard method N The measurements made with an optical system. Ν The instrument shall be calibrated to read in absolute N radiant power per unit receiving area and per unit solid angle to acceptance averaged over the field of view of the instrument. 5.2.2.2 Alternative method Р Р 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. Measurement of source size Р 5.2.3 The determination of α , the angle subtended by a Р source, requires the determination of the 50% emission points of the source. 5.2.4 Pulse width measurement for pulsed sources Ν The determination of Δt , the nominal pulse duration Ν of a source, requires the determination of the time during which the emission is > 50% of its peak value. 5.3 Analysis methods Ρ Р 5.3.1 Weighting curve interpolations To standardize interpolated values, use linear in-Р see table 4.1 terpolation on the log of given values to obtain intermediate points at the wavelength intervals desired. 5.3.2 Calculations Ρ Р The calculation of source hazard values shall be performed by weighting the spectral scan by the appropriate function and calculating the total weighted energy. 5.3.3 Measurement uncertainty Р Р The quality of all measurement results must be see Annex C in the norm quantified by an analysis of the uncertainty. LAMP CLASSIFICATION For the purposes of this standard it was decided that see table 6.1 Р the values shall be reported as follows:



IEC 62471 Clause Requirement + Test Result - Remark Verdict for lamps intended for general lighting service, N 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 for all other light sources, including pulsed lamp Р r = 200 mmsources, the hazard values shall be reported at a distance of 200 mm 6.1 Ρ Continuous wave lamps 6.1.1 Р **Exempt Group** Р In the exempt group are lamps, which does not pose any photobiological hazard. The requirement is met by any lamp that does not pose: an actinic ultraviolet hazard (E_S) within 8-hours Р exposure (30000 s), nor Р a near-UV hazard (E_{UVA}) within 1000 s, (about 16 min), nor Р a retinal blue-light hazard (L_B) within 10000 s (about 2,8 h), nor Р a retinal thermal hazard (L_R) within 10 s, nor an infrared radiation hazard for the eye (EIR) Ν within 1000 s 6.1.2 Risk Group 1 (Low-Risk) Ν In this group are lamps, which exceeds the limits for N the exempt group but that does not pose: an actinic ultraviolet hazard (Es) within 10000 s, Ν a near ultraviolet hazard (E_{UVA}) within 300 s, nor Ν a retinal blue-light hazard (LB) within 100 s, nor Ν a retinal thermal hazard (LR) within 10 s, nor Ν an infrared radiation hazard for the eye (E_{IR}) Ν within 100 s Lamps that emit infrared radiation without a strong Ν visual stimulus and do not pose a near-infrared retinal hazard (L_{IR}), within 100 s are in Risk Group 1. 6.1.3 Risk Group 2 (Moderate-Risk) Ν This requirement is met by any lamp that exceeds Ν the limits for Risk Group 1, but that does not pose: an actinic ultraviolet hazard (Es) within 1000 s Ν exposure, nor a near ultraviolet hazard (E_{UVA}) within 100 s, nor Ν a retinal blue-light hazard (LB) within 0,25 s Ν (aversion response), nor



IEC 62471 Clause Requirement + Test Result - Remark Verdict N a retinal thermal hazard (LR) within 0,25 s (aversion response), nor an infrared radiation hazard for the eye (E_{IR}) Ν within 10 s Lamps that emit infrared radiation without a strong Ν visual stimulus and do not pose a near-infrared retinal hazard (L_{IR}), within 10 s are in Risk Group 2. 6.1.4 Risk Group 3 (High-Risk) Ν Lamps which exceed the limits for Risk Group 2 are Ν in Group 3. 6.2 Pulsed lamps Ν Pulse lamp criteria shall apply to a single pulse and Ν to any group of pulses within 0,25 s. A pulsed lamp shall be evaluated at the highest Ν nominal energy loading as specified by the manufacturer. The risk group determination of the lamp being Ν tested shall be made as follows: a lamp that exceeds the exposure limit shall be Ν classified as belonging to Risk Group 3 (High-Risk) for single pulsed lamps, a lamp whose weighted Ν radiant exposure or weighted radiance does is below the EL shall be classified as belonging to the Exempt Group for repetitively pulsed lamps, a lamp whose Ν 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





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le 4.1 Spectral we	ighting function for assessing υ	ıltraviolet hazards for sk	kin and eye P
Wavelength¹ λ, nm	UV hazard function S _{υν} (λ)	Wavelength λ, nm	UV hazard function S _ω (λ)
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 0,0000	
297*	0,460	375 0,000077	
300	0,300 380 0,000		0,000064
303*	0,120 385 0,000053		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.
Emission lines of a mercury discharge spectrum.



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Table 4.2	Spectral weighting sources	functions for assessing retinal hazards fro	om broadband optical	Р	
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		

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Table 5.4	Su	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 con- stant irradiance W•m ⁻²		
Actinic UV skin & eye		$E_{S} = \sum E_{\lambda} \bullet S(\lambda) \bullet \Delta \lambda$	200 – 400	< 30000	1,4 (80)	30/t		
Eye UV-A		$E_{UVA} = \sum E_{\lambda} \bullet \Delta \lambda$	315 – 400	≤1000 >1000	1,4 (80)	10000/t 10		
Blue-light small source)	$E_B = \sum E_\lambda \bullet B(\lambda) \bullet \Delta \lambda$	300 – 700	≤100 >100	< 0,011	100/t 1,0		
Eye IR		$E_IR = \sum E_\lambda \bullet \Delta \lambda$	780 –3000	≤1000 >1000	1,4 (80)	18000/t ^{0,75} 100		
Skin thermal		$E_H = \sum E_\lambda \bullet \Delta \lambda$	380 – 3000	< 10	2π sr	20000/t ^{0,75}		

Table 5.5	Sur	Summary of the ELs for the retina (radiance based values)					Р
Hazard Na	me	Relevant equation	Wavelength range nm	Exposure duration sec	Field of view radians	EL in terms of constant radiance W•m ⁻² •sr ⁻¹)	
				0,25 – 10	0,011•√(t/10)	10 ⁶	'/t
Blue light		$L_B = \sum L_\lambda \bullet B(\lambda) \bullet \Delta \lambda$	300 – 700	10-100	0,011	10 ⁶	/t
				100-10000	0,0011•√t	10 ⁶	/t
				≥ 10000	0,1	10	0
Retinal		L 5L 2D()) 2A)	200 4400	< 0,25	0,0017	50000/(
thermal		$L_{R} = \sum L_{\lambda} \bullet R(\lambda) \bullet \Delta \lambda$	380 – 1400	0,25 – 10	0,011•√(t/10)	50000/(α•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 range





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Table 6.1	Emission limits for risk groups of continuous wave lamps							Р	
Risk	Action spectrum	Symbol	Units	Emission Measurement					
				Exempt		Low risk		Mod risk	
				Limit	Result	Limit	Result	Limit	Result
Actinic UV	S _{UV} (λ)	Es	W•m ⁻²	0,001	0	0,003		0,03	
Near UV		E _{UVA}	W•m ⁻²	10	0	33		100	
Blue light	Β(λ)	L _B	W•m ⁻² •sr ⁻¹	100	79,3	10000		4000000	
Blue light, small source	Β(λ)	E _B	W•m⁻²	1,0*		1,0		400	
Retinal thermal	R(λ)	L _R	W•m ⁻² •sr ⁻¹	28000/α	65864,8	28000/α		71000/α	
Retinal thermal, weak visual stimulus**	R(λ)	L _{IR}	W•m ⁻² •sr ⁻¹	6000/α		6000/α		6000/α	
IR radiation, eye		E _{IR}	W•m⁻²	100		570		3200	

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



List of test equipment used:

Clause	Measurement / testing	Testing / measuring equipment / material used	Range used	Calibration date
5	Irradiance and Radiance measure-	Spectroradiometer	200 – 800 nm	Last cal. date: 2010-04-08
	ments			Next cal. date: 2011-04-08
5	Irradiance and Radiance measure-	HP 34401A multimeter		Last cal. date: 2010-09-09
	ments			Next cal. date: 2011-09-09

Photo documentation

Details of:

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View:	
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