

<b>TEST REPORT</b> <b>IEC 62471:2006</b> <b>Photobiological safety of lamps and lamp systems</b>	
Report reference No .....	RSZ150813550-03M1
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Date of issue .....	2015-08-15
Testing laboratory .....	Bay Area Compliance Laboratories Corp. (Dongguan)
Address .....	No.69 Pulong Village Puxinhu Industry Zone Tangxia,Dongguan, China.
Testing location .....	Same as above
Applicant .....	Guangzhou Hongli Opto-Electronic Co., Ltd.
Address .....	No.1, Xianke Yi Road, Huadong Town, Huadu District, Guangzhou, China
Standard .....	IEC 62471:2006
Test sample(s) received.....	2015-08-14
Test in period.....	2015-08-14
Procedure deviation .....	N.A.
Non-standard test method .....	N.A.
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Type of test object .....	LED
Trademark .....	None
Model/type reference .....	HL-AF-5060H343W-3-S1-T1-HR3
Manufacturer.....	Guangzhou Hongli Opto-Electronic Co., Ltd. No.1, Xianke Yi Road, Huadong Town, Huadu District, Guangzhou, China
Rating .....	2.9-3.0Vdc I <sub>F</sub> =60mA



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 $10^4 \text{ cd m}^{-2}$	$>10^4 \text{ cd m}^{-2}$	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 $30 \text{ J.m}^{-2}$ 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:	$E_s=8.2 \times 10^{-6} \text{ W.m}^{-2}$	P
	$E_s \cdot t = \int_{200}^{400} E_\lambda(\lambda, t) \cdot S_{uv}(\lambda) \cdot t \cdot 30 \text{ J.m}^{-2}$		P
	The permissible time for exposure to ultraviolet radiation incident upon the unprotected eye or skin shall be computed by:		P
	$t_{\max} = 30/E_s$	$t_{\max} = 30 / (8.2 \times 10^{-6}) = 3.65 \times 10^6 \text{ s}$	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 $10000 \text{ J.m}^{-2}$ for exposure times less than 1000s. For exposure times greater than 1000 s (approximately 16 minutes) the UV-A irradiance for the unprotected eye, $E_{UVA}$ , shall not exceed $10 \text{ W.m}^{-2}$	$E_{UVA} = 5.7 \times 10^{-5} \text{ W.m}^{-2}$	P
	The permissible time for exposure to ultraviolet radiation incident upon the unprotected eye for time less than 1000 s, shall be computed by:		N
	$t_{\max} = 10000/E_{UVA} \text{ s}$		N
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, $LB$ , shall not exceed the levels defined by:		P

IEC 62471			
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	$L_B \cdot t = \int_{300}^{700} L(\lambda, t) \cdot B(\lambda) \cdot d\lambda \cdot t \leq 10^6 \text{ J} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$		N
	$L_B = \int_{300}^{700} L_\lambda \cdot B(\lambda) \cdot d\lambda \leq 100 \text{ W} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$	$L_B = 30 \text{ W} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$	P
4.3.4	Retinal blue light hazard exposure limit - small source	= 0.0095rad	N
	Thus the spectral irradiance at the eye $E_\lambda$ , weighted against the blue-light hazard function $B(\lambda)$ shall not exceed the levels defined by: see table 4.2		N
	$E_B \cdot t = \int_{300}^{700} E_\lambda(\lambda, t) \cdot B(\lambda) \cdot d\lambda \cdot t \leq 100 \text{ J} \cdot \text{m}^{-2}$		N
	$E_B = \int_{300}^{700} E_\lambda \cdot B(\lambda) \cdot d\lambda \leq 1 \text{ W} \cdot \text{m}^{-2}$		N
4.3.5	Retinal thermal hazard exposure limit		P
	To protect against retinal thermal injury, the integrated spectral radiance of the light source, $L_\lambda$ , 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
	$L_R = \int_{1400}^{380} L_\lambda \cdot R(\lambda) \cdot d\lambda \leq \frac{50000}{0.25 \cdot 380} \text{ W} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$	$L_R = 1.9 \times 10^4 \text{ W} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$	P
4.3.6	Retinal thermal hazard exposure limit – weak visual stimulus		P

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, LIR, as viewed by the eye for exposure times greater than 10 s shall

IEC 62471			
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	$E_{IR} = \sum_{780}^{3000} E_{\lambda} \cdot \Delta\lambda \leq 18000 \cdot t^{-0,75} \quad W \cdot m^{-2}$		N
	For times greater than 1000 s the limit becomes:		P
	$E_{IR} = \sum_{780}^{3000} E_{\lambda} \cdot \Delta\lambda \leq 100 \quad W \cdot m^{-2}$	$E_{IR}=0 \text{ W} \cdot m^{-2}$	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:		P
	$E_H \cdot t = \sum_{380}^{3000} \sum_t E_{\lambda}(\lambda, t) \cdot \Delta t \cdot \Delta\lambda \leq 20000 \cdot t^{0,25} \quad J \cdot m^{-2}$	$E_H=0 \text{ J} \cdot m^{-2}$	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)		N
	Seasoning of lamps shall be done as stated in the Appropriate EN lamp standard.		N
5.1.2	Test environment	25.3	-
	For specific test conditions, see the appropriate EN lamp standard or in absence of such standards, the appropriate national standards or manufacturer's recommendations.		-
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 EN lamp standard, or		N
	– the manufacturer' s recommendation		P
5.1.5	Lamp system operation		N
	The power source for operation of the test lamp shall be provided in accordance with:		N
	– the appropriate EN standard, or		N

IEC 62471			
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	– the manufacturer' s recommendation		N
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		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		N
	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
5.2.3	Measurement of source size		P
	The determination of $\theta$ , 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
	The determination of $t_p$ , the nominal pulse duration of a source, requires the determination of the time during which the emission is > 50% of its peak value.		N
5.3	Analysis methods		P
5.3.1	Weighting curve interpolations		N
	To standardize interpolated values, use linear interpolation on the log of given values to obtain intermediate points at the wavelength intervals desired.		N
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

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	For the purposes of this standard it was decided that the values shall be reported as follows:		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		N
	– for all other s, including pulsed lamp sources, the hazard values shall be reported at a distance of 200 mm	LED light source:200mm	P
6.1	Continuous wave lamps		P
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		P
	– an infrared radiation hazard for the eye (EIR) within 1000 s		P
6.1.2	Risk Group 1 (Low-Risk)		N
	In this group are lamps, which exceeds the limits for the except group but that does not pose:		N
	– an actinic ultraviolet hazard (ES) within 10000 s, nor		N
	– a near ultraviolet hazard (EUVA) within 300 s, nor		N
	– a retinal blue-light hazard (LB) within 100 s, nor		N
	– a retinal thermal hazard (LR) within 10 s, nor		N
	– an infrared radiation hazard for the eye (EIR) within 100 s		N
	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
6.1.3	Risk Group 2 (Moderate-Risk)		N
	This requirement is met by any lamp that exceeds the limits for Risk Group 1, but that does not pose:		N
	– an actinic ultraviolet hazard (ES) within 1000 s exposure, nor		N
	– a near ultraviolet hazard (EUVA) within 100 s, nor		N
	– a retinal blue-light hazard (LB) within 0,25 s (aversion response), nor		N
	– a retinal thermal hazard (LR) within 0,25 s (aversion response), nor		N

<b>IEC 62471</b>			
Clause	Requirement + Test	Result - Remark	Verdict
	– an infrared radiation hazard for the eye (EIR) within 10 s		N
	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
6.1.4	Risk Group 3 (High-Risk)		N
	Lamps which exceed the limits for Risk Group 2 are in Group 3.		N



<b>Table 4.1</b>		Spectral weighting function for assessing ultraviolet hazards for skin and eye		-
<b>Wavelength<sup>1</sup> , nm</b>	<b>UV hazard function S<sub>uv</sub>( )</b>	<b>Wavelength , nm</b>	<b>UV hazard function S<sub>uv</sub>( )</b>	
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	

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

<b>Table 4.2</b>		Spectral weighting functions for assessing retinal hazards from broadband optical sources		-
<b>Wavelength nm</b>		<b>Blue-light hazard function B()</b>	<b>Burn hazard function R()</b>	
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

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

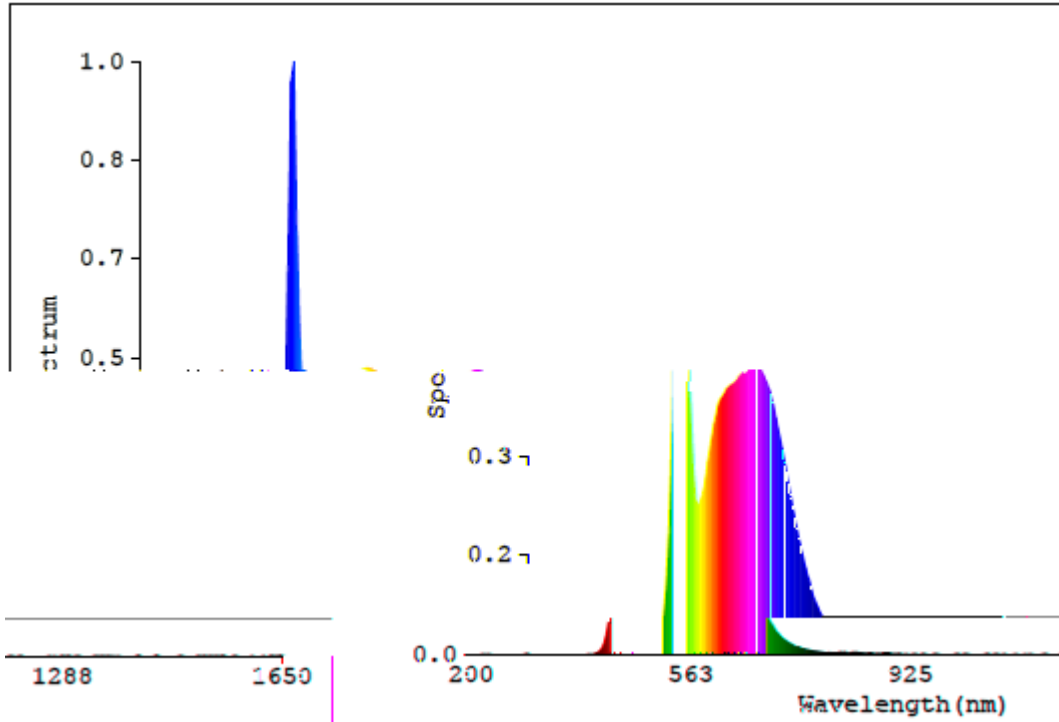
<b>Table 5.5</b>		Summary of the ELs for the retina (radiance based values)			-
<b>Hazard Name</b>	<b>Relevant equation</b>	<b>Wavelength Range nm</b>	<b>Exposure duration Sec</b>	<b>Field of view radians</b>	<b>EL in terms of constant radiance <math>W.m^{-2}.sr^{-1}</math></b>
Blue light	$L_B = L \cdot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

Table 6.1		Emission limits for risk groups of continuous wave lamps base on Directive(2006/25/EC)							P	
Risk	Action spectrum	Units	Symbol	Exempt		Low risk		Mod risk		
				Limit	Result	Limit	Result	Limit	Result	
Actinic UV	Suv( )	W.m <sup>-2</sup>	E <sub>S</sub>	0.001	8.2x10 <sup>-6</sup>	0.003	-	0.03	-	
Near UV		W.m <sup>-2</sup>	E <sub>UVA</sub>	10	5.7x10 <sup>-5</sup>	33	-	100	-	
Blue light	B( )	W.m <sup>-2</sup> .sr <sup>-1</sup>	L <sub>B</sub>	100	30	10000	-	4000000	-	
Blue light,small source	B( )	W.m <sup>-2</sup>	E <sub>B</sub>	1*	-	0.48	-	400	-	
Retinal thermal	R( )	W.m <sup>-2</sup> .sr <sup>-1</sup>	L <sub>R</sub>	28000/ =0.0145	1.9x10 <sup>4</sup>	28000/ =0.0145	-	71000/ =0.0145	-	
Retinal thermal, Weak visual stimulus**	R( )	W.m <sup>-2</sup> .sr <sup>-1</sup>	L <sub>IR</sub>	6000/ =0.0145	1.3x10 <sup>2</sup>	6000/ =0.0145	-	28000/ =0.0145	-	
IR radiation Eye		W.m <sup>-2</sup>	E <sub>IR</sub>	100	0	570	-	3200	-	

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

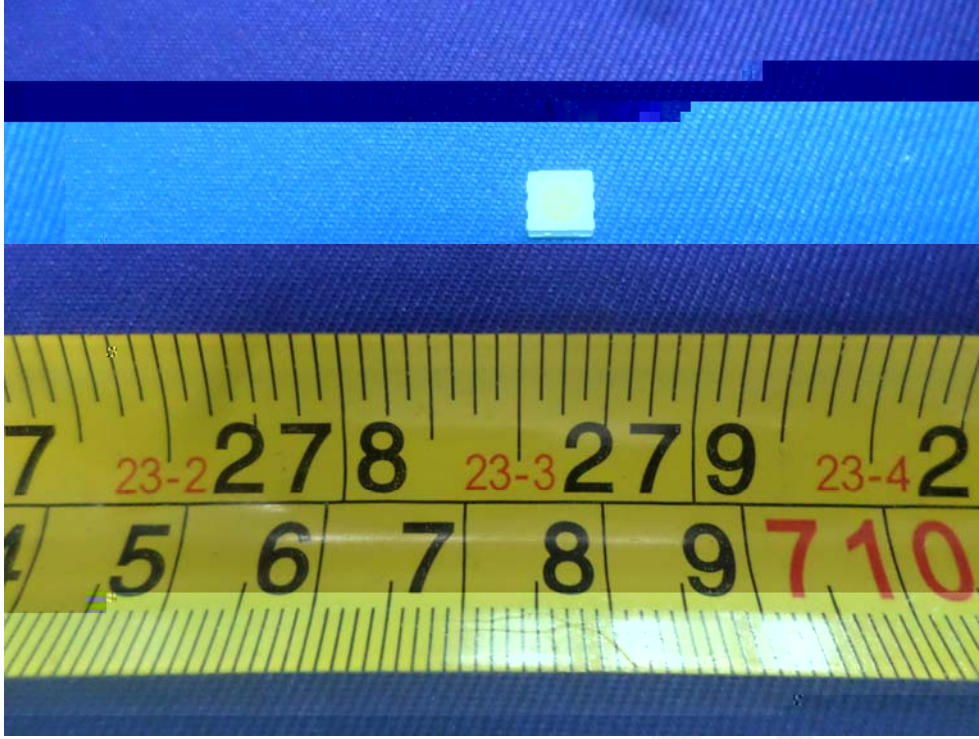
### Appendix I Figure of Spectral distribution

Spectral distribution of LED



## Appendix A - EUT Photos

### 1. General view of LED



### Appendix B Test equipment list

Equipment Description	Model No	BACL#	Manufacturer	Last Cal	Cal Due
UV light leakage spectrum of biological safety systems	PMS-300	T-08-EE042	EVERFINE	2015-3-25	2016-3-24
Standard power spectral UV radiation-specific	UVS-8003	T-08-EE048	EVERFINE	2014-8-2	2015-8-2
80mm sample integrating sphere	SMS-300	T-08-EE055	EVERFINE	2015-3-25	2016-3-24
Radio meter	RD-2000	T-08-EE056	EVERFINE	2015-3-25	2016-3-24
high-accuracy digital photometer head	HAAS-2000	T-08-EE058	EVERFINE	2015-3-25	2016-3-24
Hygrothermograph	PWS280	T-08-QA026	N/A	2013-4-1	2016-3-30
Steel tape	HILOCK-19	T-08-SF100	TAJIMA	2013-4-18	2018-4-17