TEST REPORT

IEC 62471:2006

Photobiological safety of lamps and lamp systems

Report reference No ..... :	RSZ150706551-03M1
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Date of issue ..... :	2015-07-09
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..... :	2015-07-07
Test in period..... :	2015-07-08
Procedure deviation ..... :	N.A.
Non-standard test method ..... :	N.A.

[redacted]

Type of test object ..... :	LED Package
Trademark ..... :	None
Model/type reference ..... :	HL-A-2835D46W-S1-08-HR3
Manufacturer..... ..... :	Guangzhou Hongli Opto-Electronic Co., Ltd. No.1, Xianke Yi Road, Huadong Town, Huadu District, Guangzhou, China
Rating ..... :	180mA

General product information:

Model	Input parameters	CCT
HL-A-2835D46W-S1-08-HR3	180mA	5700K
		5000K
		4000K
		3000K

From above table, all models have same electrical parameters. They difference just in CCT.
5700K is the worse case,which could cover other CCT.Unless otherwise specified, the 5700K was chosen as the representative models to perform the test.

Remarks:
The measured LED, part number HL-A-2835D46W-S1-08-HR3, with ANSI bin 5700K.


FIN!

	$L_B = \sum_{300}^{700} L_\lambda \cdot B(\lambda) \cdot \triangle\lambda \leq 100$ W·m^{-2}·sr^{-1}	L_B=81 W·m-2·sr-1	P
4.3.4	Retinal blue light hazard exposure limit - small source	= 0.0040 rad	P
	Thus the spectral irradiance at the eye E_, weighted against the blue-light hazard function B(_) shall not exceed the levels defined by: see table 4.2		P
	$E_B \cdot t = \sum_{300}^{700} E_\lambda(\lambda,t) \cdot B(\lambda) \cdot \triangle t \cdot \triangle\lambda \leq 100$ J·m^{-2}		N
	$E_B = \sum_{300}^{700} E_\lambda \cdot B(\lambda) \cdot \triangle\lambda \leq 1$ W·m^{-2}	E_B=0.34W·m^{-2}	P
4.3.5	Retinal thermal hazard exposure limit		P
	To protect against retinal thermal injury, the integrated spectral radiance of the light source, L_, weighted by the burn hazard weighting function R(_) (from Figure 4.2 and Table 4.2), i.e., the burn hazard weighted radiance, shall not exceed the levels defined by:		P
	$L_R = \sum_{380}^{1400} L_\lambda \cdot R(\lambda) \cdot \Delta\lambda \leq \frac{50000}{\alpha \cdot t^{0,25}}$ W·m^{-2}·sr^{-1}	L_R=6.8x10^{4}W·m^{-2}·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 be limited to:		P
	$L_{IR} = \sum_{780}^{1400} L_\lambda \cdot R(\lambda) \cdot \Delta\lambda \leq \frac{6000}{\alpha}$ W·m^{-2}·sr^{-1}	L_{IR}=2.3x10^{2}W·m^{-2}·sr^{-1}	P
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, EIR,over the wavelength range 780 nm to 3000 nm, for times less than 1000 s, shall not exceed:		N
	$E_{IR} = \sum_{780}^{3000} E_\lambda \cdot \Delta\lambda \leq 18000 \cdot t^{-0,75}$ W·m^{-2}		N
	For times greater than 1000 s the limit becomes:		P

	$E_{IR} = \sum_{780}^{3000} E_\lambda \cdot \Delta\lambda \le 100$ W·m^{-2}	E_{IR}=0 W·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
	$E_H \cdot t = \sum_{380}^{3000} \sum_{t} E_\lambda(\lambda,t) \cdot \Delta t \cdot \Delta\lambda \le 20000 \cdot t^{0,25}$ J·m^{-2}	E_H= 0 J·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
	– 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.	See appendix B	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 , 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, 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 quantified by an analysis of the uncertainty.		P

6	LAMP CLASSIFICATION		P
	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	LED light for general lighting: 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
6.1	Continuous wave lamps		P
6.1.1	Exempt Group		P

	The risk group determination of the lamp being tested shall be made as follows:		N
	– a lamp that exceeds the exposure limit shall be classified as belonging to Risk Group 3 (High-Risk)		N
	– 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
	– 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

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

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.

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

Wavelength nm	Blue-light hazard function B( )	Burn hazard function R( )
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	$10^{[(450-)/50]}$	1,0
600-700	0,001	1,0
700-1050	0,013	$10^{[(700-)/500]}$
1050-1150	0,025	0,2
1150-1200	0,05	$0,2.^{100.02(1150-)}$
1200-1400	0,10	0,02

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

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 aperture rad(deg)**	**Limiting aperture rad(deg)**	**EL in items of constant irradiance $W.m^{-2}$**
Actinic UV skin & eye	$E_S = E \bullet S(\ ) \bullet$	200 – 400	< 30000	1,4 (80)	30/t
Eye UV-A	$E_{UVA} = E \bullet$	315 – 400	1000 >1000	1,4 (80)	10000/t 10
Blue-light small source	$E_B = E \bullet B(\ ) \bullet$	300 – 700	100 >100	< 0,011	100/t 1,0
Eye IR	$E_{IR} = E \bullet$	780 –3000	1000 >1000	1,4 (80)	$18000/t^{0,75}$ 100
Skin thermal	$E_H = E \bullet$	380 – 3000	< 10	2 sr	$20000/t^{0,75}$

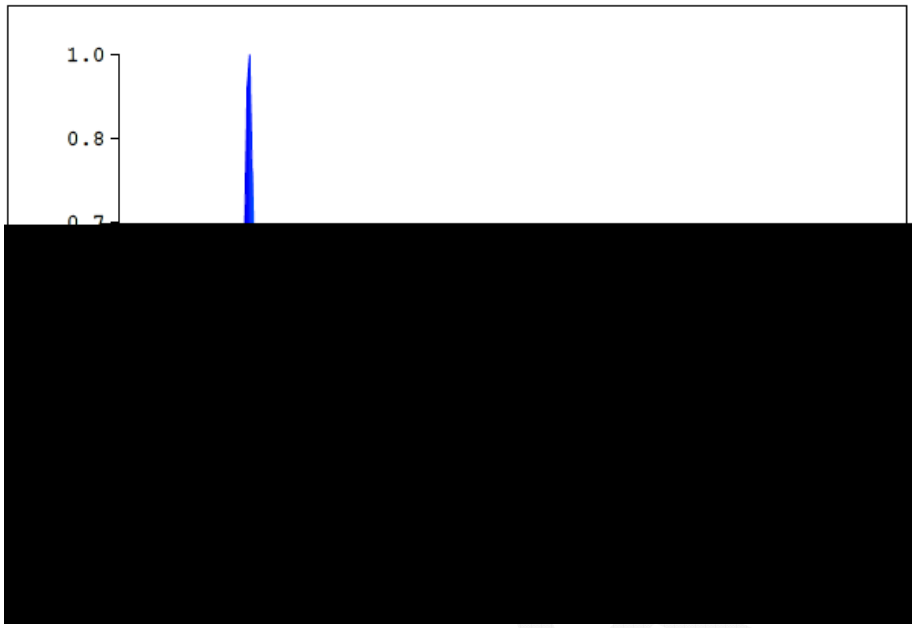
Table 5.5	Summary of the ELs for the retina (radiance based values)				-
Hazard Name	**Relevant equation**	**Wavelength Range nm**	**Explosure duration Sec**	**Field of view radians**	**EL in terms of constant radiance $W.m^{-2}.sr^{-1}$)**
Blue light	$L_B = L \bullet B(\ ) \bullet$	300 – 700	0,25 – 10 10-100 100-10000 10000	0,011• (t/10) 0,011 0,0011• t 0,1	$10^6/t$ $10^6/t$ $10^6/t$ 100
Retinal thermal	$L_R = L \bullet R(\ ) \bullet$	380 – 1400	< 0,25 0,25 – 10	0,0017 0,011• (t/10)	$50000/(\ \bullet t^{0,25})$ $50000/(\ \bullet t^{0,25})$
Retinal thermal (weak visual stimulus)	$L_{IR} = L \bullet R(\ ) \bullet$	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( )	$W.m^{-2}$	E_S	0.001	3.7×10^{-6}	0.003	-	0.03	-
Near UV		$W.m^{-2}$	E_{UVA}	10	1.8×10^{-4}	33	-	100	-
Blue light	B( )	$W.m^{-2}.sr^{-1}$	L_B	100	81	10000	-	4000000	-
Blue light,small source	B( )	$W.m^{-2}$	E_B	1*	0.34	1	-	400	-
Retinal thermal	R( )	$W.m^{-2}.sr^{-1}$	L_R	28000/ =0.0040	$6.8x10^4$	28000/ =0.0040	-	71000/ =0.0040	-
Retinal thermal, Weak visual stimulus**	R( )	$W.m^{-2}.sr^{-1}$	L_{IR}	6000/ =0.0040	2.3×10^2	6000/ =0.0040	-	28000/ =0.0040	-
IR radiation Eye		$W.m^{-2}$	E_{IR}	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

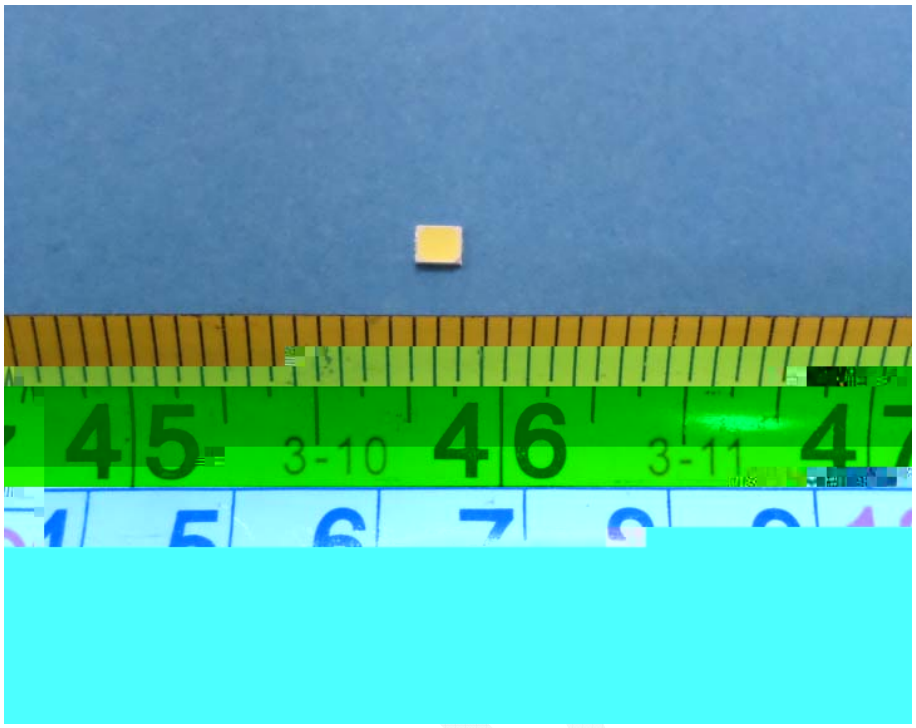
Appendix I Figure of Spectral distribution

Spectral distribution of 5700K



Appendix A - EUT Photos

1. General view of 5700K



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