TEST REPORT

IEC 62471:2006

Photobiological safety of lamps and lamp systems

Report reference No	:	RSZ200619551-SF
Compiled by (+ signature)	:	Engineer: Zero Gao
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Date of issue	:	2020-07-01

Testing laboratory	:	Bay Area Compliance Laboratories Corp. (Dongguan)
Address	:	No.69, Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, Guangdong, China
Testing location	:	Same as above

Applicant	:	Hongli Zhihui Group Co., Ltd. Guangzhou Branch
Address	:	Room 316, Building 2, No.1, Xianke Yi Road, Huadong Town, Huadu District, Guangzhou, China

Standard	:	IEC 62471:2006
Test sample(s) received.....	:	2020-06-26
Test in period.....	:	2020-06-30
Procedure deviation	:	N.A.
Non-standard test method	:	N.A.

Type of test object	:	LED package
Trademark	:	N.A.
Model/type reference	:	HL-C3535K9A1EA-FC
Manufacturer.....	:	Hongli Zhihui Group Co., Ltd. Guangzhou Branch Room 316, Building 2, No.1, Xianke Yi Road, Huadong Town, Huadu District, Guangzhou, China
Rating	:	Input: 3Vdc, 1200mA

Copy of marking plate:

None

Test item particulars

Tested lamp .....: LED Package
Tested lamp system .....: N.A

Lamp classification group.....: Exempt Group
Lamp cap .....: N.A
Bulb.....: N.A
Rated of the lamp .....: See rating
Furthermore marking on the lamp.....: N.A.
Seasoning of lamps according EN

IEC 62471:2006			
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 have been applied instead of those fixed in IEC 62471: 2006	See Table 6.1	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
			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:	Es=1.168 x 10^{-9} $W\cdot m^{-2}$	P
	$Es\cdot t=\sum_{200}^{400}\sum_{t} E(\lambda,t)\cdot s_{uv}(\lambda)\cdot\triangle t\cdot\triangle\lambda\leq 30 \quad J\cdot m^{-2}$		P
	The permissible time for exposure to ultraviolet radiation incident upon the unprotected eye or skin shall be computed by:		P
	$t_{max}=30/E_s$	$t_{max}=30/(1.168 \times 10^{-9})=$ 2.568 x 10^{10}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 $J.m^{-2}$ 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 $W\cdot m^{-2}$	See 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:		N
	$t_{max}\leq 10000/E_{UVA}$ s		N
4.3.3	Retinal blue light hazard exposure limit		P

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	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(_), i.e., the blue-light weighted radiance , LB, shall not exceed the levels defined by:		P
	$L_B \cdot t = \sum_{300}^{700} \sum_{t} L_\lambda(\lambda,t) \cdot B(\lambda) \cdot \triangle t \cdot \triangle \lambda \leq 10^6$ J·m^{-2}·sr^{-1}		N
	$L_B = \sum_{300}^{700} L \cdot B(\lambda) \cdot \triangle \lambda \leq 100$ W·m^{-2}·sr^{-1}	See Table 6.1	P
4.3.4	Retinal blue light hazard exposure limit - small source	α=0.0140	N
	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		N
	$E_B \cdot t = \sum_{300}^{700} \sum_{t} E(\lambda,t) \cdot B(\lambda) \cdot \triangle t \cdot \triangle \lambda \leq 100$ J·m^{-2}		N
	$E_B = \sum_{300}^{700} E \cdot B(\lambda) \cdot \triangle \lambda \leq 1$ W·m^{-2}	See Table 6.1	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_, 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
	$L_{IR} = \sum_{38}^{1400} L_\lambda \cdot R(\lambda) \cdot \Delta\lambda \leq \frac{50000}{\alpha \cdot t^{0.25}}$ W·m^{-2}·sr^{-1}	See Table 6.1	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}	See Table 6.1	P

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	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
	$E_{IR} = \sum_{780}^{3000} E_\lambda \cdot \Delta\lambda \le 18000 \cdot t^{-0,75}$ $W \cdot m^{-2}$		N
	For times greater than 1000 s the limit becomes:		P
	$E_{IR} = \sum_{780}^{3000} E_\lambda \cdot \Delta\lambda \le 100$ $W \cdot m^{-2}$	See Table 6.1	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
	$E_H \cdot t = \sum_{380}^{3000} \sum_{t} E_\lambda(\lambda,t) \cdot \Delta t \cdot \Delta\lambda \le 20000 \cdot t^{0,25}$ $J \cdot m^{-2}$	$E_{H \cdot t}$= 4.933$W \cdot m^{-2}$ x 10s =4.933 x $10^1 J \cdot m^{-2}$	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.	Measured at distance of 200mm	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	25.7℃	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		P
	Operation of the test lamp shall be provided in accordance with:		P

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	– 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.		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 α, the angle subtended by a source, requires the determination of the 50% emission points of the source.	α=0.0140	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

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	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		N
	– for all other light sources, including pulsed lamp sources, the hazard values shall be reported at a distance of 200 mm		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

FIN

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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	$10^{[(450-\lambda)/50]}$	1,0
600-700	0,001	1,0
700-1050	0,013	$10^{[(700-\lambda)/500]}$
1050-1150	0,025	0,2
1150-1200	0,05	$0,2.^{100.02(1150-\lambda)}$
1200-1400	0,10	0,02

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

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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**	**Explosure aperture rad(deg)**	**Limiting aperture rad(deg)**	**EL in items of constant 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	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	$L_B = \sum L_\lambda \bullet B(\lambda) \bullet \Delta\lambda$	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	$L_R = \sum L_\lambda \bullet R(\lambda) \bullet \Delta\lambda$	380 – 1400	< 0,25 0,25 – 10	0,0017 0,011•√(t/10)	$50000/(\alpha \bullet t^{0,25})$ $50000/(\alpha \bullet t^{0,25})$
Retinal thermal (weak visual stimulus)	$L_{IR} = \sum L_\lambda \bullet R(\lambda) \bullet \Delta\lambda$	780 – 1400	> 10	0,011	6000/α

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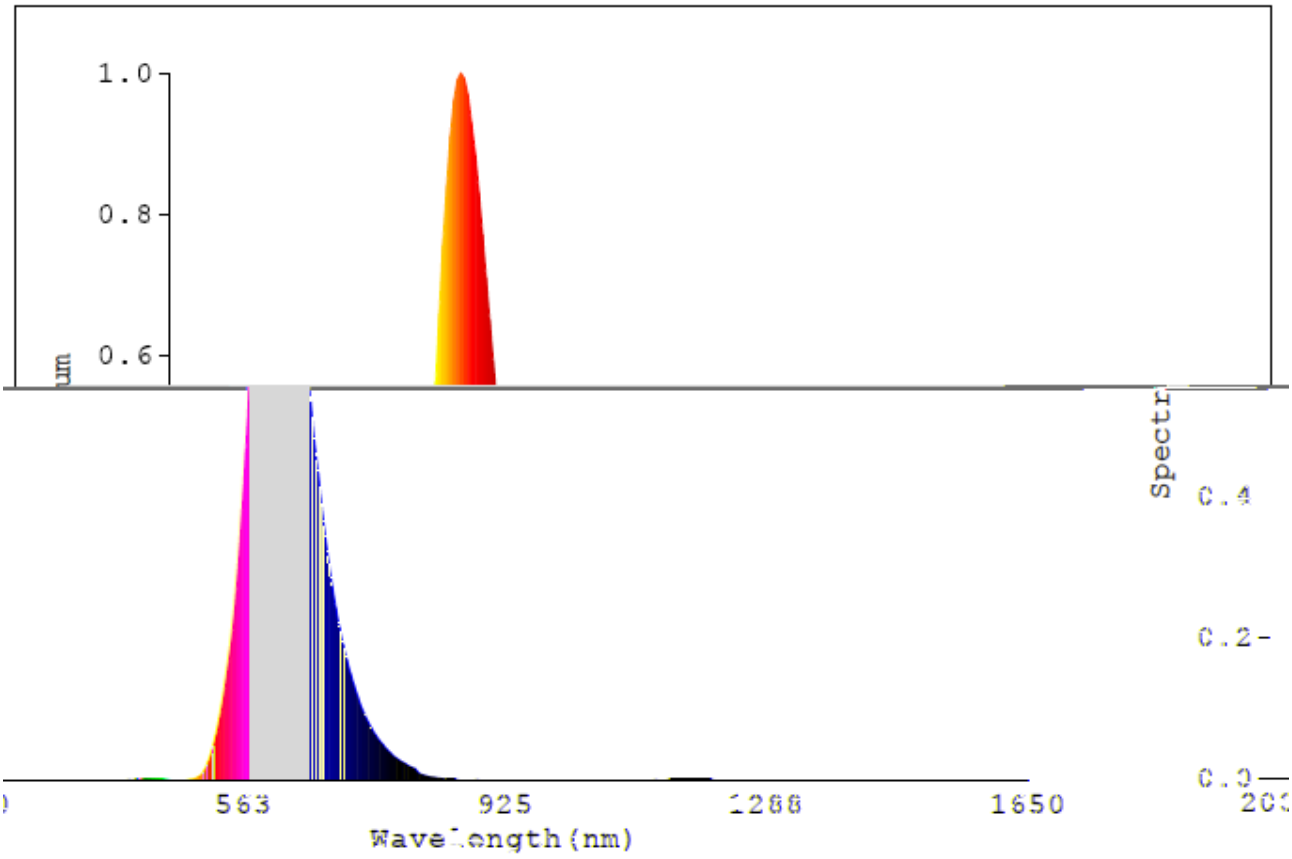
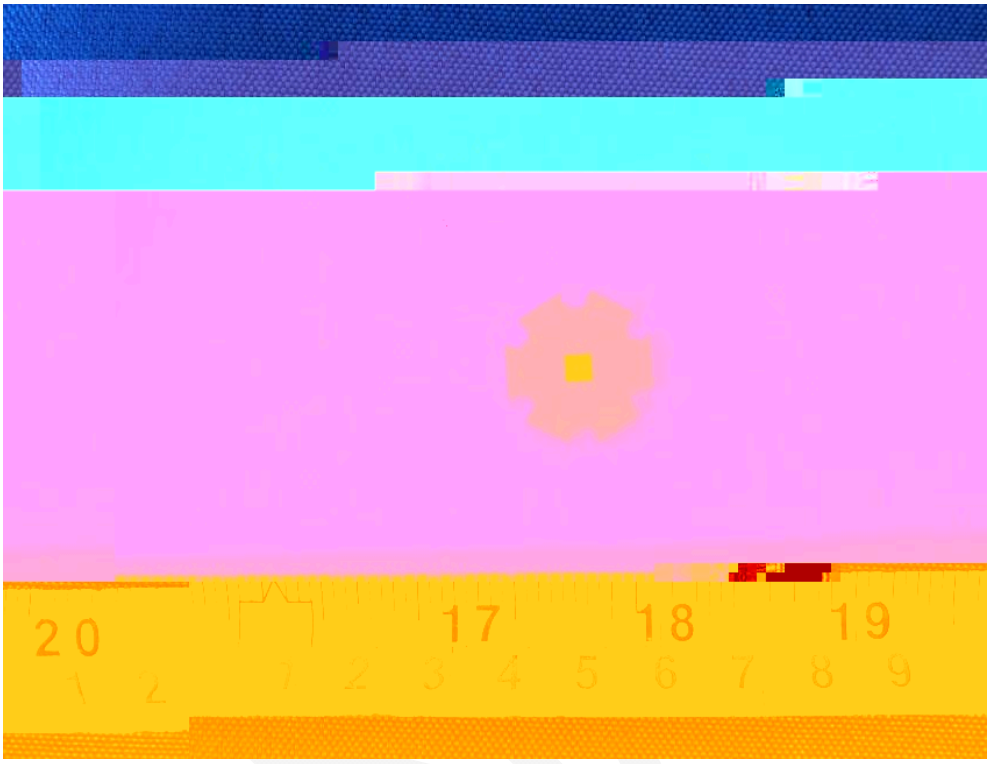
Table 6.1	Emission limits for risk groups of continuous wave lamps		P
Risk			

Figure of Spectral distribution



Appendix A - EUT Photos

EUT - The overall view



DIRECTIONS

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