

<b>TEST REPORT</b> <b>IEC 62471:2006</b> <b>Photobiological safety of lamps and lamp systems</b>	
Report reference No .....	SZ2240314-12722E-SF
Compiled by (+ signature) .....	Engineer: Max Li
Approved by (+ signature) .....	Team Leader:Harrison Huang
Date of issue .....	2024-03-22
Testing laboratory .....	Bay Area Compliance Laboratories Corp. (Dongguan)
Address .....	No.12, Pulong East 1 <sup>st</sup> Road, Tangxia Town, 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.....	2024-03-14
Test in period.....	2024-03-14
Procedure deviation .....	N.A.
Non-standard test method .....	N.A.
Type of test object .....	LED package
Trademark .....	NA
Model/type reference .....	HL-C3535K4B3GA
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: 3.0-3.8Vdc,700mA
Copy of marking plate:	None

<b>Test item particulars:</b>	
Tested lamp .....	:LED package
Tested lamp system .....	:N.A
<b>Lamp classification group.....: Risk Group 2</b>	
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 standard .....	: No seasoning
Temperature by measurement.....	:22.5°C
Information for safety use.....	:N.A

<b>Possible test case verdicts:</b>	
-test case does not apply to the test object.....	:N(.A.)
-test object does meet the requirement.....	:P(ass)
-test object does not meet the requirement.....	:F(ail)

**General remarks:**

The test results presented in this report relate only to the object tested.  
 This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.  
 "(See Enclosure #)" refers to additional information appended to the report.  
 "(See appended table)" refers to a table appended to the report.  
 Throughout this report a point is used as the decimal separator.

**Remark:**  
**Appendix A - EUT photos**

**General Product Information:**

"EUT" as referred in this report is LED package, the test model is HL-C3535K4B3GA.

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

IEC 62471:2006			
Clause	Requirement Test	Result - Remark	Verdict
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
	$L_B \cdot t = \int_{300}^{700} L_\lambda(\lambda, t) \cdot B(\lambda) \cdot t \cdot \lambda \leq 10^6 \text{ J} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$		N
	$L_B = \int_{300}^{700} L_\lambda \cdot B(\lambda) \cdot \lambda \leq 100 \text{ W} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$	See Table 6.1	P
4.3.4	Retinal blue light hazard exposure limit - small source	=0.0100	P
	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		P
	$E_B \cdot t = \int_{300}^{700} E_\lambda(\lambda, t) \cdot B(\lambda) \cdot t \cdot \lambda \leq 100 \text{ J} \cdot \text{m}^{-2}$		P
	$E_B = \int_{300}^{700} E_\lambda \cdot B(\lambda) \cdot \lambda \leq 1 \text{ W} \cdot \text{m}^{-2}$		P
4.3.5	Retinal thermal hazard exposure limit		P
	To protect against retinal thermal injury, the integrated spectral radiance of the light source, $L_\lambda$ , 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
	$L_B = \int_{780}^{1400} L_\lambda \cdot R(\lambda) \cdot \lambda \leq 50000 \text{ W} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$	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
	$L_{IR} = \sum_{780}^{1400} L_\lambda \cdot R(\lambda) \cdot \Delta\lambda \leq \frac{6000}{\alpha} \text{ W} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$	See Table 6.1	P

IEC 62471:2006				
Clause	Requirement	Test	Result - Remark	Verdict
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 <sup>-2</sup>		N
	For times greater than 1000 s the limit becomes:			P
	$E_{IR} = \sum_{780}^{3000} E_{\lambda} \cdot \Delta\lambda \leq 100$	W·m <sup>-2</sup>	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
	$E_H \cdot t = \sum_{380}^{3000} \sum_t E_{\lambda}(\lambda, t) \cdot \Delta t \cdot \Delta\lambda \leq 20000 \cdot t^{0,25}$	J·m <sup>-2</sup>	$E_H \cdot t = 3.967 \times 10 = 39.67 \text{ J} \cdot \text{m}^{-2}$	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 AppropriateEN lamp standard.			N
5.1.2	Test environment		22.5	P
	For specific test conditions, see the appropriateEN 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

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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.			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.	$\theta = 0.0100$		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

IEC 62471:2006				
Clause	Requirement	Test	Result - Remark	Verdict
	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

IEC 62471:2006				
Clause	Requirement	Test	Result - Remark	Verdict
	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)			P
	This requirement is met by any lamp that exceeds the limits for Risk Group 1, but that does not pose:			P
	– an actinic ultraviolet hazard (ES) within 1000 s exposure, nor			P
	– a near ultraviolet hazard (EUVA) within 100 s, nor			P
	– a retinal blue-light hazard (LB) within 0,25 s (aversion response), nor			P
	– a retinal thermal hazard (LR) within 0,25 s (aversion response), nor			P
	– an infrared radiation hazard for the eye (EIR) within 10 s			P
	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.			P
6.1.4	Risk Group 3 (High-Risk)			N
	Lamps which exceed the limits for Risk Group 2 are in Group 3.			N
6.2	Pulsed lamps			N
	Pulse lamp criteria shall apply to a single pulse and to any group of pulses within 0,25 s.			N
	A pulsed lamp shall be evaluated at the highest nominal energy loading as specified by the manufacturer.			N
	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



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<b>Table 4.1</b>	Spectral weighting function for assessing ultraviolet hazards for skin and eye		-
<b>Wavelength <math>\lambda</math>, nm</b>	<b>UV hazard function</b>		

IEC 62471:2006			
Clause	Requirement	Test	Verdict

<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
	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	$0,2 \cdot 100,02^{(1150-)}$
	1200-1400	0,10	0,02
* Wavelengths chosen are representative: other values should be obtained by logarithmic interpolation at intermediate wavelengths.			

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Clause	Requirement	Test	Result - Remark		Verdict

\*Emission lines of a mercury discharge spectrum.

<b>Table 5.4</b> 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	$E_S = E \cdot S(\bullet)$	200 – 400	< 30000	1,4 (80)	30/t
Eye UV-A	$E_{UVA} = E \cdot \bullet$	315 – 400	1000 >1000	1,4 (80)	10000/t 10
Blue-light small source	$E_B = E \cdot B(\bullet)$	300 – 700	100 >100	< 0,011	100/t 1,0
Eye IR	$E_{IR} = E \cdot \bullet$	780 – 3000	1000 >1000	1,4 (80)	18000/t <sup>0,75</sup> 100
Skin thermal	$E_H = E \cdot \bullet$	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)					
Hazard Name	Relevant equation	Wavelength Range nm	Exposure duration Sec	Field of view radians	EL in terms of constant radiance $W.m^{-2}.sr^{-1}$
Blue light	$L_B = L \cdot B(\bullet) \cdot \bullet$	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	$L_R = L \cdot R(\bullet) \cdot \bullet$	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)	$L_{IR} = L \cdot R(\bullet) \cdot \bullet$	780 – 1400	> 10	0,011	6000/

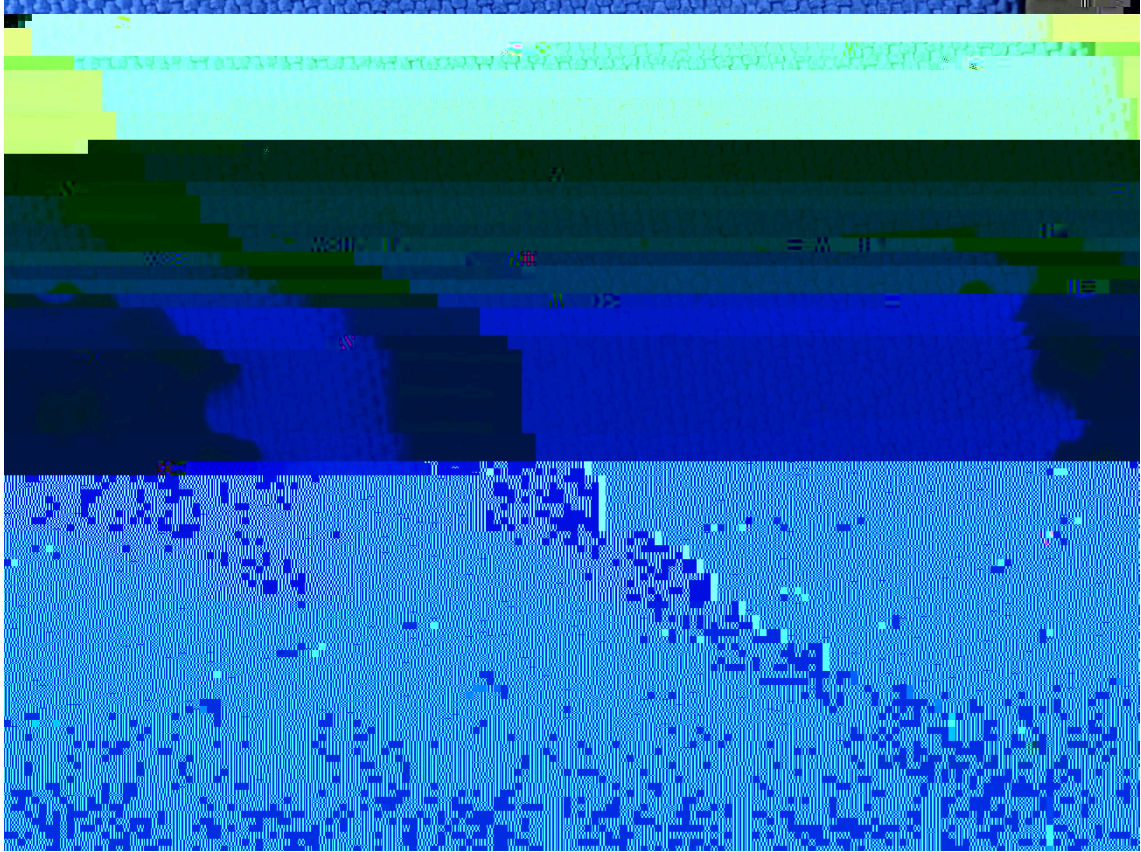
IEC 62471:2006				
Clause	Requirement	Test	Result - Remark	Verdict

Table 6.1	Emission limits for risk groups of continuous wave lamps								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	-	0.003	-	0.03	3.054×10 <sup>-3</sup>
Near UV		W.m <sup>-2</sup>	E <sub>UVA</sub>	10	-	33	-	100	6.517×10 <sup>-4</sup>
Blue light	B( )	W.m <sup>-2</sup> .sr <sup>-1</sup>	L <sub>B</sub>	100	-	10000	-	4000000	8.092×10 <sup>4</sup>
Blue light,small source	B( )	W.m <sup>-2</sup>	E <sub>B</sub>	1.0	-	1.0	-	400	6.631
Retinal thermal	R( )	W.m <sup>-2</sup> .sr <sup>-1</sup>	L <sub>R</sub>	28000/ ( =0.0100)	-	28000/ ( =0.0100)	-	71000/ ( =0.0100)	8.096×10



## Appendix A - EUT Photos

The overall view of EUT



**Directions**

- 1.The information marked # is provided by the applicant, the laboratory is not responsible for its authenticity and this information can affect the validity of the result in the test report.
- 2.Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.
- 3.Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.
- 4.The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.
- 5.This report cannot be reproduced except in full, without prior written approval of the Company.
- 6.This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.
- 7.For the difference between the tested model and the multiple models, the applicant had provided a statement and promised to be responsible for its authenticity. The laboratory has confirmed the difference of relevant samples before testing.

**\*\*\*End of report\*\*\***