TEST REPORT

IEC 62471:2006

Photobiological safety of lamps and lamp systems

Report reference No ..... :	RSZ200909560-SF
Compiled by (+ signature) ..... :	Engineer: Cloud Zheng
Approved by (+ signature) ..... :	Project Engineer: Harrison Huang
Date of issue ..... :	2020-09-16
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..... :	2020-09-14
Test in period..... :	2020-09-15
Procedure deviation ..... :	N.A.
Non-standard test method ..... :	N.A.
Type of test object ..... :	LED Package
Trademark ..... :	N.A
Model/type reference ..... :	HL-ES-3032S23V405-B2-S1
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, 150mA

Copy of marking plate:

None

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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
	Detailed spectral data of a light source are generally required only if the luminance of the source exceeds 10^4 cd m^{-2}	>10^4 cd m^{-2}	P
4.3	Hazard exposure limits		P g U24(iVf)-0(h

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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(_), i.e., the blue-light weighted radiance , LB, shall not exceed the levels defined by:		P
	$L_{B,t} = \sum_{300}^{700} L(\lambda,t) \cdot B(\lambda) \cdot \Delta\lambda \cdot t \cdot 10^6$ J·m^{-2}·sr^{-1} $L_B = \sum_{300}^{700} L_\lambda \cdot B(\lambda) \cdot \Delta\lambda \cdot 100$ W·m^{-2}·sr^{-1}		N

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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
	$E_{IR} = \sum_{780}^{3000} E_\lambda \cdot \Delta\lambda \le 18000 \cdot t^{-0,75}$ $W \cdot m^{-2}$		P
	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: $E_H \cdot t = \sum_{380}^{3000} \sum_{t} E_\lambda(\lambda,t) \cdot \Delta t \cdot \Delta\lambda \le 20000 \cdot t^{0,25}$ $J \cdot m^{-2}$	$E_H \cdot t = 3.748 \times 1016 Tw$	P

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	Operation of the test lamp shall be provided in accordance with:		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

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	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
	– 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
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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Table 4.1	Spectral weighting function for assessing ultraviolet hazards for skin and eye		-
Wavelength[1]	**UV hazard function S_{uv}**	**Wavelength**	**UV hazard function S_{uv}**
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.

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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	$E_S = \times E_{\partial} \AA S(\partial) \bullet \text{æ}\partial$	200 – 400	< 30000	1,4 (80)	30/t
Eye UV-A	$E_{UVA} = \times E_{\partial} \bullet \text{æ}\partial$	315 – 400	Ò1000 >1000	1,4 (80)	10000/t 10
Blue-light small source	$E_B = \times E_{\partial} \AA B(\partial) \bullet \text{æ}\partial$	300 – 700	Ò100 >100	< 0,011	100/t 1,0
Eye IR	$E_{IR} = \times E_{\partial} \bullet \text{æ}\partial$	780 –3000	Ò1000 >1000	1,4 (80)	$18000/t^{0,75}$ 100
Skin thermal	$E_H = \times E_{\partial} \bullet \text{æ}\partial$	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	$L_B = \times L_{\partial} \AA B(\partial) \text{Å} \text{æ}\partial$	300 – 700	0,25 – 10 10-100 100-10000 Ó10000	0,011•ã(t/10) 0,011 0,0011•ãt 0,1	10^6/t 10^6/t 10^6/t 100
Retinal thermal	$L_R = \times L_{\partial} \AA R(\partial) \text{Å} \text{æ}\partial$	380 – 1400	< 0,25 0,25 – 10	0,0017 0,011•ã(t/10)	$50000/(\check{U}\text{Å}^{0,25})$ $50000/(\check{U}\text{Å}^{0,25})$
Retinal thermal (weak visual stimulus)	$L_{IR} = \times L_{\partial} \AA R(\partial) \bullet \text{æ}\partial$	780 – 1400	> 10	0,011	6000/Ŭ

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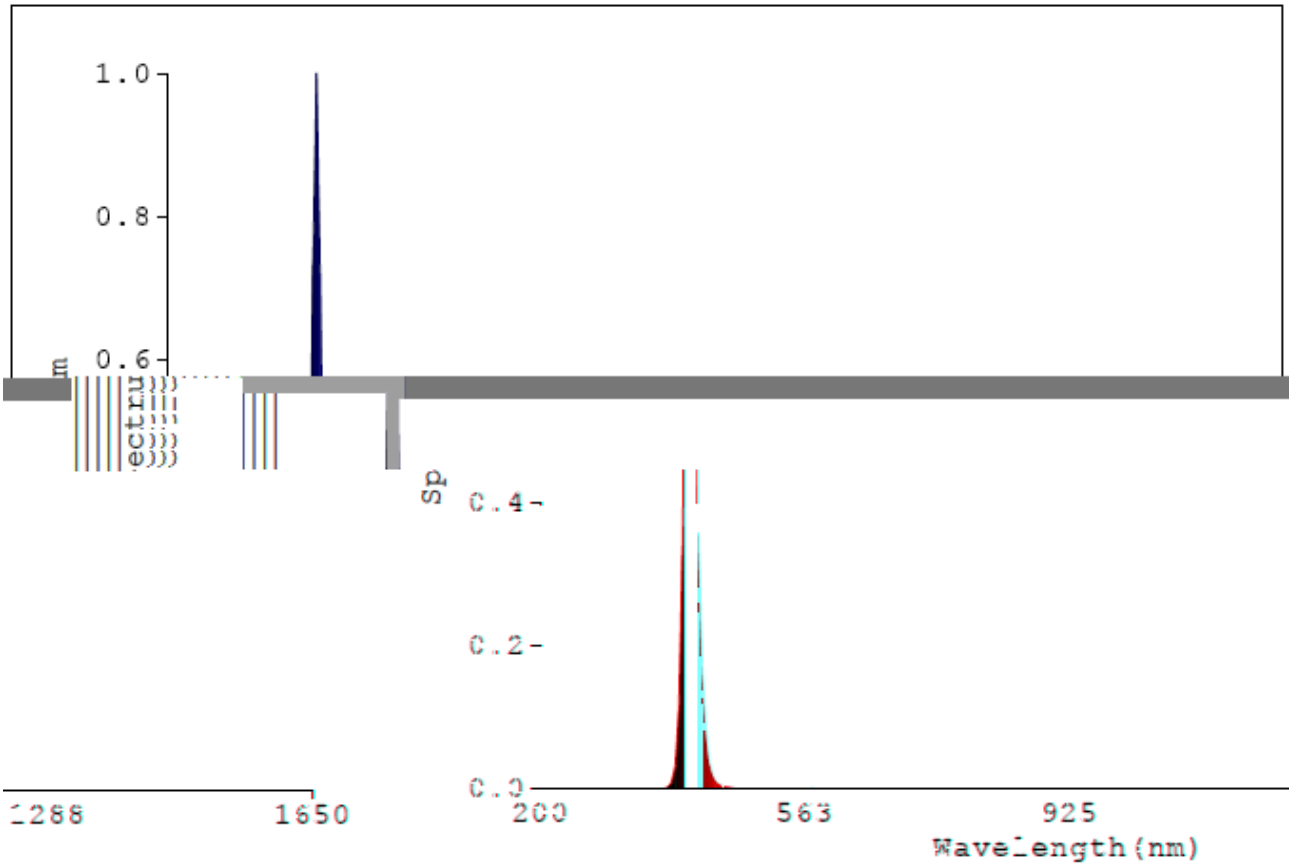
Table 6.1	Emission limits for risk groups of continuous wave lamps								P
Risk	Action spectrum	Units	Symbol	Exempt		Low risk		Mod risk	
				Limit	Result	Limit	Result	Limit	Result
Actinic UV	Suv(λ)	$W.m^{-2}$	E_S	0.001	3.062×10^{-6}	0.003	--	0.03	--
Near UV		$W.m^{-2}$	E_{UVA}	10	8.665×10^{-2}	33	--	100	--
Blue light	B(λ)	$W.m^{-2}.sr^{-1}$	L_B	100	1.980×10^{1}	10000	--	4000000	--
Blue light,small source	B(λ)	$W.m^{-2}$	E_B	1.0	1.218×10^{-1}	1.0	--	400	--
Retinal thermal	R(λ)	$W.m^{-2}.sr^{-1}$	L_R	28000/Ŭ (Ŭ=0.0040)	1.396×10^{4}	28000/Ŭ (Ŭ=0.0040)	--	71000/Ŭ (Ŭ=0.0040)	--
Retinal thermal, Weak visual stimulus**	R(λ)	$W.m^{-2}.sr^{-1}$	L_{IR}	6000/Ŭ (Ŭ=0.0040)	0	6000/Ŭ (Ŭ=0.0040)	--	6000/Ŭ (Ŭ=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

NOTE The action functions: see Table 4.1 and Table 4.2
The applicance apertuer diameters: see 4.2.1
The limitations for the angular subtenses: see 4.2.2
The related measurement condition 5.2.3 and the range of acceptance angles: see Table 5.5

Figure of Spectral distribution



Appendix A - EUT Photos

EUT - The overall view