Report No.: SZ2220310-08295E-SF

TEST REPORT

IEC 62471:2006

Photobiological safety of lamps and lamp systems

Report reference No ..... :	SZ2220310-08295E-SF
Compiled by (+ signature) ..... :	Engineer: Zero Gao
Approved by (+ signature) ..... :	Team Leader: Harrison Huang
Date of issue ..... :	2022-03-24
Testing laboratory ..... :	Bay Area Compliance Laboratories Corp. (Dongguan)
Address ..... :	No.12, Pulong East 1st 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..... :	2022-03-14
Test in period..... :	2022-03-16
Procedure deviation ..... :	N.A.
Non-standard test method ..... :	N.A.
Type of test object ..... :	LED package
Trademark ..... :	N.A.
Model/type reference ..... :	HL-EMC-3030RGB-S1-W-D
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: Red light: 1.9-2.4Vdc, 60mA; Green light: 2.7-3.3Vdc, 60mA; Blue light: 2.7-3.3Vdc, 60mA

Copy of marking plate:

None

Test item particulars

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

Lamp classification group.....: Red light: Exempt Group;
Green light: Exempt Group;
Blue light: 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 standard .....: No seasoning
Temperature by measurement.....: 24.5° C
Information for safety use.....: N.A

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
	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
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:	See Table 6.1	P
	$Es \cdot t = \sum_{200}^{400} \sum_{t} E\lambda(\lambda,t) \cdot s_{uv}(\lambda) \cdot \triangle t \cdot \triangle \lambda \leq 30 \quad J \cdot m^{-2}$		P
	The permissible time for exposure to ultraviolet radiation incident upon the unprotected eye or skin shall be computed by:		P
	$t_{max}=30/E_s$		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·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

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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
	$L_B \cdot t = \sum_{300}^{700} \sum_{t} L_\lambda(\lambda,t) \cdot B(\lambda) \cdot \triangle t \cdot \triangle\lambda \leq 10^6$ J·m^{-2}·sr^{-1}		N
	$L_B = \sum_{300}^{700} L_\lambda \cdot B(\lambda) \cdot \triangle\lambda \leq 100$ W·m^{-2}·sr^{-1}	See Table 6.1	P
4.3.4	Retinal blue light hazard exposure limit - small source		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
	$E_B \cdot t = \sum_{300}^{700} \sum_{t} E_\lambda(\lambda,t) \cdot B(\lambda) \cdot \triangle t \cdot \triangle\lambda \leq 100$ J·m^{-2}		N
	$E_B = \sum_{300}^{700} E_\lambda \cdot B(\lambda) \cdot \triangle\lambda \leq 1$ W·m^{-2}		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
	$L = \sum_{38}^{1400} L_\lambda \cdot R(\lambda) \cdot \Delta\lambda \leq \frac{50000}{\alpha^{1.25}}$ 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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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
	$E_{IR} = \sum_{780}^{3000} E_\lambda \cdot \Delta\lambda \le 18000 \cdot t^{-0,75}$ $W \cdot m^{-2}$		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
	$E_H \cdot t = \sum_{380}^{3000} \sum_{t} E_\lambda(\lambda,t) \cdot \Delta t \cdot \Delta\lambda \le 20000 \cdot t^{0,25}$ $J \cdot m^{-2}$		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 a distance of 200 mm.	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	24.5° C	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

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	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 ac2 16af71.7 408.8 .72 16.4132.10 7997 ref71the m0 Tw700.6(method)4.9( )]TJ2		

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Clause	Requirement – Test	Result - Remark	Verdict
	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] 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.

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Clause	Requirement – Test	Result - Remark	Verdict

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.

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* 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**	**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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Clause	Requirement – Test	Result - Remark	Verdict

For Red light:

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	1.401×10^{-5}	0.003	-	0.03	-
Near UV		$W.m^{-2}$	E_{UVA}	10	0	33	-	100	-
Blue light	B(λ)	$W.m^{-2}.sr^{-1}$	L_B	100	3.196×10^{-2}	10000	-	4000000	-
Blue light,small source	B(λ)	$W.m^{-2}$	E_B	1.0	3.117×10^{-4}	1.0	-	400	-
Retinal thermal	R(λ)	$W.m^{-2}.sr^{-1}$	L_R	28000/α (α=0.0020rad)	1.529×10^{3}	28000/α (α=0.0020rad)	-	71000/α (α=0.0020rad)	-
Retinal thermal, Weak visual stimulus**	R(λ)	$W.m^{-2}.sr^{-1}$	L_{IR}	6000/α (α=0.0020rad)	0	6000/α (α=0.0020rad)	-	6000/α (α=0.0020rad)	-
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

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Verdict

P

risk

				Limit	Result	Limit	Result		

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Clause	Requirement – Test	Result - Remark	Verdict

For Blue light:

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	1.785×10^{-4}	0.003	-	0.03	-
Near UV		$W.m^{-2}$	E_{UVA}	10	4.351×10^{-5}	33	-	100	-
Blue light	B(λ)	$W.m^{-2}.sr^{-1}$	L_B	100	5.038×10^{1}	10000	-	4000000	-
Blue light,small source	B(λ)	$W.m^{-2}$	E_B	1.0	3.890×10^{-1}	1.0	-	400	-
Retinal thermal	R(λ)	$W.m^{-2}.sr^{-1}$	L_R	28000/α (α=0.0017rad)	2.244×10^{4}	28000/α (α=0.0017rad)	-	71000/α (α=0.0017rad)	-
Retinal thermal, Weak visual stimulus**	R(λ)	$W.m^{-2}.sr^{-1}$	L_{IR}	6000/α (α=0.0017rad)	7.565×10^{-1}	6000/α (α=0.0017rad)	-	6000/α (α=0.0017rad)	-
IR radiation Eye		$W.m^{-2}$	E_{IR}	100	0	570	-	3200	-

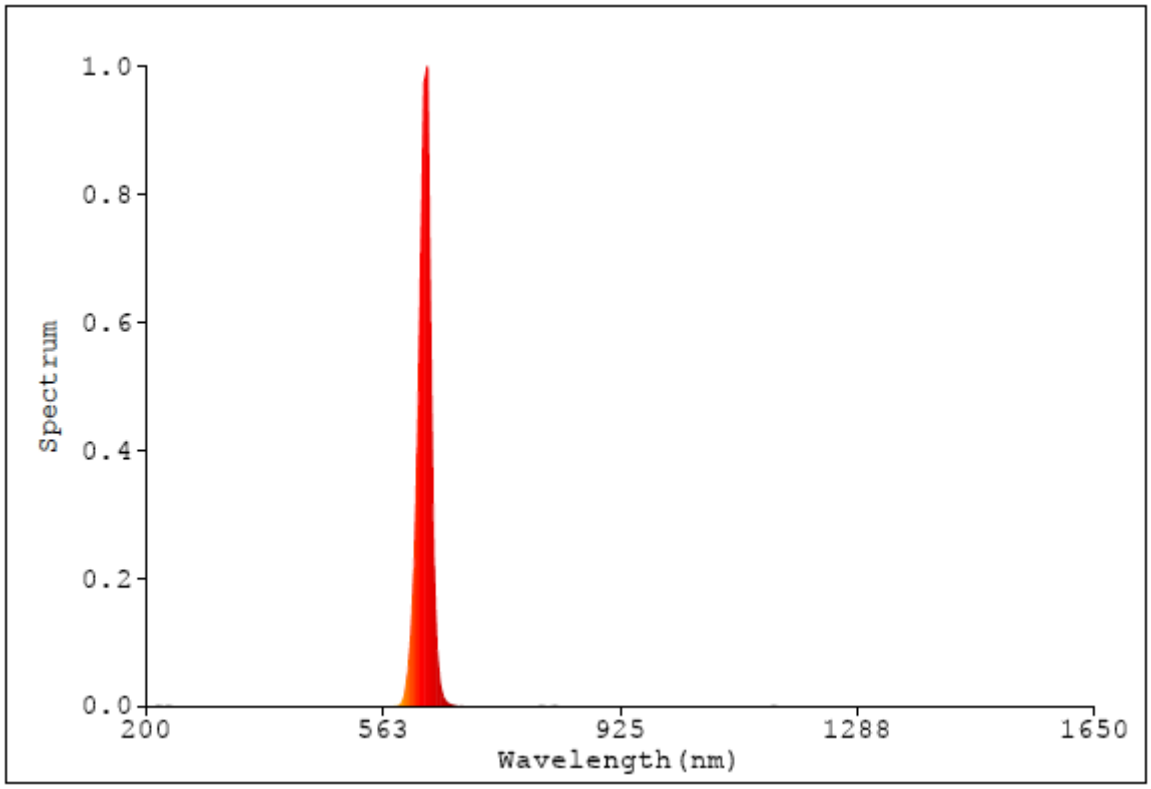
* Small source defined as one with < 0,011 radian. Averaging field of view at 10000 s is 0,1 radian.

** Involves evaluation of non-GLS source

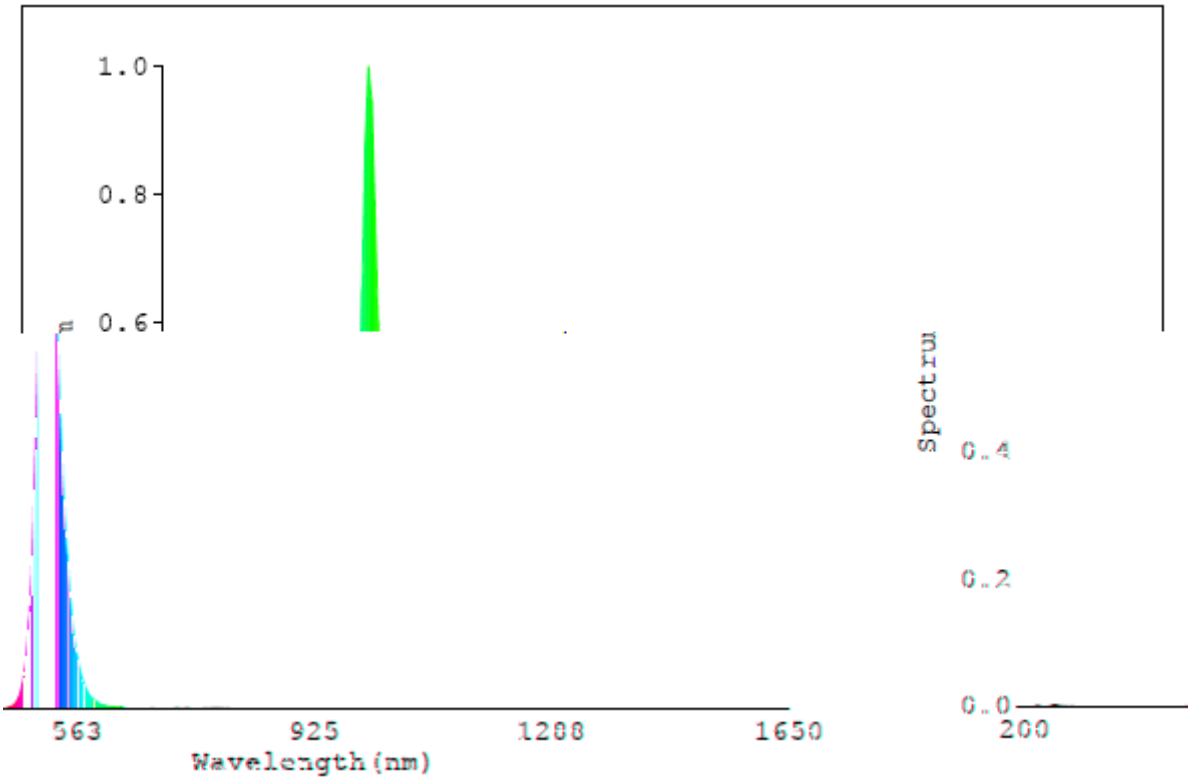
NOTE The action functions: see Table 4.1 and Table 4.2
The applicance apertuer diameters: see 4.2.1
The limitations for the angular subtenses: see 4.2.2
The related measurement condition 5.2.3 and the range of acceptance angles: see Table 5.5

Figure of Spectral distribution

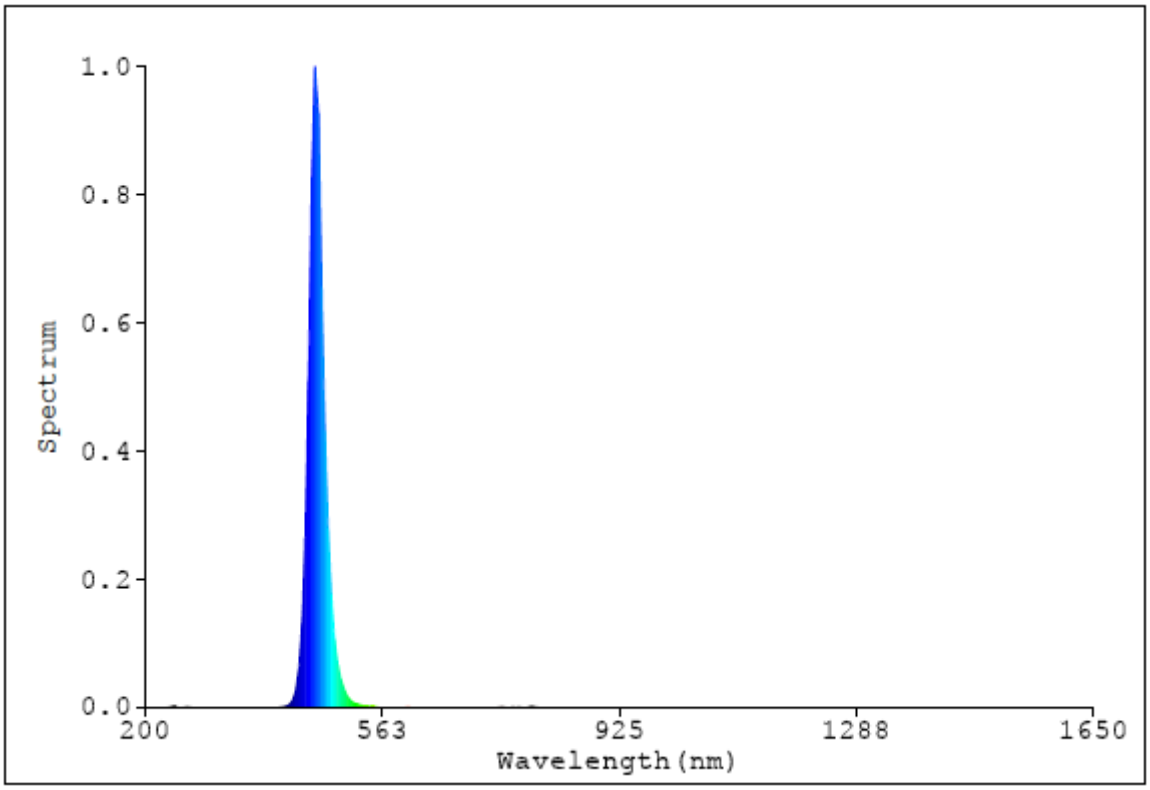
For Red light:



For Green light:



For Blue light:



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.

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