TPSI 毅豐光電股份有限公司 燈具實驗室
Taiwan Photometric Solution Inc
70953 台南市海中街 288 號 TEL：(06)2568831 FAX：(06)2563437
E-mail：light.lab@msa.hinet.net Web：www.lightlab.com.tw

TAF
Testing Laboratory
2262

Photobiological safety of lamps and lamp systems

Test Standard： IEC 62471 (2006)

Date of Receipt：2017 / 03 / 24

Test Date：2017 / 03 / 24 ~ 2017 / 03 / 30

Result of determination this subclass type experiment：**Exempt Group**

1. Issue Date for test report：2017 / 03 / 30
2. Report No：17032403
3. Total pages：17
4. Test report without steel stamp is not valid, and shall not be reproduced except in full.
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Approved Signatory：

SERIES OF TEST REPORT (IEC 62471)
Report Reference No：17032403 Date of issue：2017 / 03 / 30 Tested by (signature)：Shun-Yuan Cheng Approved by (signature)：Zhu-Wei Huang
Testing Laboratory：Taiwan Photometric Solution Inc Testing location/ address：No.228, Haizhong St., Annan Dist., Tainan City 709, Taiwan (R.O.C.) Cetificate No：TAF 2262
Applicant：Paragon Semiconductor Lighting Technology Co., Ltd Applicant address：3F., No. 369, Sec. 2, Wenhua 2nd Rd., Linkou Dist. New Taipei City Manufacturer：Paragon Semiconductor Lighting Technology Co., Ltd Manufacturer address：3F., No. 369, Sec. 2, Wenhua 2nd Rd., Linkou Dist. New Taipei City
Test specification： Standard：IEC 62471 (2006)
Possible test case verdicts – test case does not apply to the test object：N/A – test object does meet the requirement：P (Pass) – test object does not meet the requirement：F (Fail)
Testing： Date of receipt of test item：2017 / 03 / 24 Date(s) of performance of tests：2017 / 03 / 24 until 2017 / 03 / 30 Result：Exempt Group
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 TPSI. The report was made that was following IEC 62471 individual standards.

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Test Report

Information for test items

Applicant：Paragon Semiconductor Lighting Technology Co., Ltd

Applicant address：3F., No. 369, Sec. 2, Wenhua 2nd Rd., Linkou Dist. New Taipei City

Manufacturer：Paragon Semiconductor Lighting Technology Co., Ltd

Manufacturer address：3F., No. 369, Sec. 2, Wenhua 2nd Rd., Linkou Dist. New Taipei City

Trademark or brand name : Paragon

Product name : LED Module

Model : CBHT-84-30135-230V-3000K

Rated input voltage :220-240V 50/60Hz

Test input voltage：230V / 60Hz

Rated input power (W)：8

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Test Content

Clause	Requirement + Test (IEC 62471)	Result – Remark	Verdict
4	**EXPOSURE LIMITS**		
4.1	General		
	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}	see clause 4.3	P
4.3	Hazard exposure limits		
4.3.1	Actinic UV hazard exposure limit for the skin and eye	see table 6.1	P
	The exposure limit for effective radiant exposure is 30 J·m^{-2} within any 8-hour period	see table 4.1	P
	To protect against injury of the eye or skin from ultraviolet radiation exposure produced by a broadband source, the effective integrated spectral irradiance , E_S, of the light source shall not exceed the levels defined by: $E_s \cdot t = \sum_{200}^{400} \sum_{t} E_\lambda(\lambda,t) \cdot S_{UV}(\lambda) \cdot \Delta t \cdot \Delta\lambda \le 30$ J·m^{-2}	see table 5.4	P
	The permissible time for exposure to ultraviolet radiation incident upon the unprotected eye or skin shall be computed by: $t_{max} = \frac{30}{E_s}$ s	see table 5.4	P
4.3.2	Near-UV hazard exposure limit for eye	see table 6.1	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 1000 s. 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 4.1	P

Clause	Requirement + Test (IEC 62471)	Result – Remark	Verdict
	The permissible time for exposure to ultraviolet radiation incident upon the unprotected eye for time less than 1000 s, shall be computed by: $t_{max} \leq \frac{10\,000}{E_{UVA}}$ s	see table 4.1	P
4.3.3	Retinal blue light hazard exposure limit	see table 6.1	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(λ), i.e., the blue-light weighted radiance , L_B, shall not exceed the levels defined by: $L_B \cdot t = \sum_{300}^{700} \sum_{t} L_\lambda(\lambda,t) \cdot B(\lambda) \cdot \Delta t \cdot \Delta\lambda \leq 10^6$ J · m^{-2} · sr^{-1} ($t \leq 10^4$ s) $L_B = \sum_{300}^{700} L_\lambda \cdot B(\lambda) \cdot \Delta\lambda \leq 100$ W · m^{-2} · sr^{-1} ($t > 10^4$ s)	see table 4.2	P
4.3.4	Retinal blue light hazard exposure limit - small source	see table 6.1	N/A
	Thus the spectral irradiance at the eye E_λ, weighted against the blue-light hazard function B(λ) shall not exceed the levels defined by: $E_B \cdot t = \sum_{300}^{700} \sum_{t} E_\lambda(\lambda,t) \cdot B(\lambda) \cdot \Delta t \cdot \Delta\lambda \leq 100$ J · m^{-2} $E_B = \sum_{300}^{700} E_\lambda \cdot B(\lambda) \cdot \Delta\lambda \leq 1$ W · m^{-2}	see table 4.2	N/A
4.3.5	Retinal thermal hazard exposure limit	see table 6.1	P
	To protect against retinal thermal injury, the integrated spectral radiance of the light source, L_λ, weighted by the burn hazard weighting function R(λ) (from Figure 4.2 and Table 4.2), i.e., the burn hazard weighted radiance, shall not exceed the levels defined by: $L_R = \sum_{380}^{1400} L_\lambda \cdot R(\lambda) \cdot \Delta\lambda \leq \frac{50\,000}{\alpha \cdot t^{0,25}}$ W · m^{-2} · sr^{-1} (10 μs ≤ t ≤ 10 s)	see table 4.2	P

Clause	Requirement + Test (IEC 62471)	Result – Remark	Verdict
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, L_{IR}, as viewed by the eye for exposure times greater than 10 s shall be limited to: $L_{IR} = \sum_{780}^{1400} L_\lambda \cdot R(\lambda) \cdot \Delta\lambda \le \frac{6000}{\alpha}$ $W \cdot m^{-2} \cdot sr^{-1}$	see table 4.2	P
4.3.7	Infrared radiation hazard exposure limits for the eye		N/A
	The avoid thermal injury of the cornea and possible delayed effects upon the lens of the eye (cataractogenesis), ocular exposure to infrared radiation, E_{IR}, over the wavelength range 780 nm to 3000 nm, for times less than 1000 s, shall not exceed: $E_{IR} = \sum_{780}^{3000} E_\lambda \cdot \Delta\lambda \le 18000 \cdot t^{-0,75}$ $W \cdot m^{-2}$ For times greater than 1000 s the limit becomes: $E_{IR} = \sum_{780}^{3000} E_\lambda \cdot \Delta\lambda \le 100$ $W \cdot m^{-2}$		N/A
4.3.8	Thermal hazard exposure limit for the skin		N/A
	Visible and infrared radiant exposure (380 nm to 3000 nm) of the skin shall be limited to: $E_H \cdot t = \sum_{380}^{3000} \sum_{t} E_\lambda(\lambda,t) \cdot \Delta t \cdot \Delta\lambda \le 20000 \cdot t^{0,25}$ $J \cdot m^{-2}$ ($t \le 10$ s)		N/A
5	MEASUREMENT OF LAMPS AND LAMP SYSTEMS		
5.1	Measurement conditions		
	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)		
	Seasoning of lamps shall be done as stated in the appropriate IEC lamp standard.		P

Clause	Requirement + Test (IEC 62471)	Result – Remark	Verdict
5.1.2	Test environment		
	For specific test conditions, see the appropriate IEC lamp standard or in absence of such standards, the appropriate national standards or manufacturer's recommendations.	the temperature of test environment is 25.1℃	P
5.1.3	Extraneous radiation		
	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		
	Operation of the test lamp shall be provided in accordance with: – the appropriate IEC lamp standard, or – the manufacturer' s recommendation		P
5.1.5	Lamp system operation		
	The power source for operation of the test lamp shall be provided in accordance with: – the appropriate IEC standard, or – the manufacturer' s recommendation		P
5.2	Measurement procedure		
5.2.1	Irradiance measurements		
	Minimum aperture diameter 7mm. 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 alibrated.		P
5.2.2	Radiance measurements		
5.2.2.1	Standard method 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		
	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.		P

Clause	Requirement + Test (IEC 62471)	Result – Remark	Verdict
5.2.3	Measurement of source size		
	The determination of α, 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		
	The determination of Δt, the nominal pulse duration of a source, requires the determination of the time during which the emission is > 50% of its peak value.	not pulsed sources	N/A
5.3	Analysis methods		
5.3.1	Weighting curve interpolations		
	To standardize interpolated values, use linear interpolation on the log of given values to obtain intermediate points at the wavelength intervals desired.	see table 4.1	P
5.3.2	Calculations		
	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		
	The quality of all measurement results must be quantified by an analysis of the uncertainty.		P
6	**LAMP CLASSIFICATION**		
	For the purposes of this standard it was decided that the values shall be reported as follows:	see table 6.1	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/A
	– for all other light sources, including pulsed lamp sources, the hazard values shall be reported at a distance of 200 mm		P

Clause	Requirement + Test (IEC 62471)	Result – Remark	Verdict
6.1	Continuous wave lamps		
6.1.1	Exempt Group		
	In the exempt group are lamps, which does not pose any photobiological hazard. The requirement is met by any lamp that does not pose: – an actinic ultraviolet hazard (E_S) within 8-hours exposure (30000 s), nor – a near-UV hazard (E_{UVA}) within 1000 s, (about 16 min), nor – a retinal blue-light hazard (L_B) within 10000 s (about 2,8h), nor – a retinal thermal hazard (L_R) within 10 s, nor – an infrared radiation hazard for the eye (E_{IR}) within 1000s Lamps that emit infrared radiation without a strong visual stimulus and do not pose a near-infrared retinal hazard (L_{IR}), within 1000 s are in Except Group	see table 6.1	P
6.1.2	Risk Group 1 (Low-Risk)		
	In this group are lamps, which exceeds the limits for the except group but that does not pose: – an actinic ultraviolet hazard (E_S) within 10000 s, nor – a near ultraviolet hazard (E_{UVA}) within 300 s, nor – a retinal blue-light hazard (L_B) within 100 s, nor – a retinal thermal hazard (L_R) within 10 s, nor – an infrared radiation hazard for the eye (E_{IR}) within 100 s Lamps that emit infrared radiation without a strong visual stimulus and do not pose a near-infrared retinal hazard (L_{IR}), within 100 s are in Risk Group 1	see table 6.1	N/A
6.1.3	Risk Group 2 (Moderate-Risk)		
	This requirement is met by any lamp that exceeds the limits for Risk Group 1, but that does not pose: – an actinic ultraviolet hazard (E_S) within 1000 s exposure, nor – a near ultraviolet hazard (E_{UVA}) within 100s,nor – a retinal blue-light hazard (L_B) within 0,25 s (aversion response), nor	see table 6.1	N/A

Clause	Requirement + Test (IEC 62471)	Result – Remark	Verdict
	– a retinal thermal hazard (L_R) within 0,25s (aversion response), nor an infrared radiation hazard for the eye (E_{IR}) within 10 s Lamps that emit infrared radiation without a strong visual stimulus and do not pose a near-infrared retinal hazard (L_{IR}), within 10 s are in Risk Group 2.		
6.1.4	Risk Group 3 (High-Risk)		
	Lamps which exceed the limits for Risk Group 2 are in Group 3.	see table 6.1	N/A
6.2	Pulsed lamps		
	Pulse lamp criteria shall apply to a single pulse and to any group of pulses within 0,25 s. A pulsed lamp shall be evaluated at the highest nominal energy loading as specified by the manufacturer. The risk group determination of the lamp being tested shall be made as follows: – a lamp that exceeds the exposure limit shall be classified as belonging to Risk Group 3 (High- Risk) – 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 – 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	not pulsed lamps	N/A

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Clause	Requirement + Test (IEC 62471)	Result – Remark	Verdict
Table 4.1	Spectral weighting function for assessing ultraviolet hazards for skin and eye		P

Wavelength/nm	UV hazard function $S_{UV}(\lambda)$	Wavelength/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

Wavelengths chosen are representative: other values should be obtained by logarithmic interpolation at intermediate wavelengths.

* Emission lines of a mercury discharge spectrum.

Clause	Requirement + Test (IEC 62471)	Result – Remark	Verdict
Table 4.2	Spectral weighting functions for assessing retinal hazards from broadband optical sources		P

Wavelength/nm	Blue-light hazard function B(λ)	Burn hazard function R(λ)
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

Clause	Requirement + Test (IEC 62471)	Result – Remark	Verdict
Table 4.2	Spectral weighting functions for assessing retinal hazards from broadband optical sources		P

Wavelength/nm	Blue-light hazard function B(λ)	Burn hazard function R(λ)
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	-	$10^{[(700-\lambda)/500]}$
1050~1150	-	0.2
1150~1200	-	$0.2\times10^{0.02(1150-\lambda)}$
1200~1400	-	0.2

Clause	Requirement + Test (IEC 62471)	Result – Remark	Verdict
Table 5.4	Spectral weighting functions for assessing retinal hazards from broadband optical sources		P

Hazard Name	Relevant equation	Wavelength range / nm	Exposure duration sec	Limiting aperture rad (deg)	EL in terms of constant irradiance $W\cdot m^{-2}$
Actinic UV skin & eye	$E_S = \sum E_\lambda \cdot S(\lambda) \cdot \Delta\lambda$	200~400	<30000	1.4(80)	30/t
Eye UV-A	$E_{UVA} = \sum E_\lambda \cdot \Delta\lambda$	315~400	≤1000 >1000	1.4(80)	10000/t 10
Blue-light small source	$E_B = \sum E_\lambda \cdot B(\lambda) \cdot \Delta\lambda$	300~700	≤100 >100	<0.011	100/t 1.0
Eye IR	$E_{IR} = \sum E_\lambda \cdot \Delta\lambda$	780~3000	≤1000 >1000	1.4(80)	$18000/t^{0,75}$
Skin thermal	$E_H = \sum E_\lambda \cdot \Delta\lambda$	380~3000	<10	2πsr	$20000/t^{0,75}$

Clause	Requirement + Test (IEC 62471)			Result – Remark		Verdict
Table 5.5	Summary of the ELs for the retina (radiance based values)					P
Hazard Name	Relevant equation	Wavelength range / nm	Exposure duration sec	Field of view radians	EL in terms of constant irradiance $W \cdot m^{-2} \cdot sr^{-1}$	
Blue light	$L_B = \sum L_\lambda \cdot B(\lambda) \cdot \Delta\lambda$	300~700	0.25~10 10~100 100~10000 ≥ 10000	$0.011 \cdot \sqrt{(t/10)}$ 0.011 $0.0011 \cdot \sqrt{t}$ 0.11	$10^6/t$ $10^6/t$ $10^6/t$ 100	
Retinal thermal	$L_R = \sum L_\lambda \cdot R(\lambda) \cdot \Delta\lambda$	380~1400	< 0.25 0.25~10	0.0017 $0.011 \cdot \sqrt{(t/10)}$	$50000/(\alpha \cdot t^{0,25})$ $50000/(\alpha \cdot t^{0,25})$	
Retinal thermal (weak visual stimulus)	$L_{IR} = \sum L_\lambda \cdot R(\lambda) \cdot \Delta\lambda$	780~1400	>10	0.011	6000/α	

Clause	Requirement + Test (IEC 62471)								Result – Remark	Verdict
Table 6.1	Emission limits for risk groups of continuous wave lamps									P
Additional Model of test：CBHT-84-30135-230V-3000K										
Risk	Action spectrum	Symbol	Emission Measurement							Units
			Exempt		Low risk		Mod risk			
			Limit	Result	Limit	Result	Limit	Result		
Actinic UV	$S_{UV}(\lambda)$	E_S	0.001	1.68E-04	0.003	-	0.03	-		$W \cdot m^{-2}$
Near UV		E_{UVA}	10	1.23E-04	33	-	100	-		$W \cdot m^{-2}$
Blue light	**B**(λ)	L_B	100	23.1816	10000	-	4000000	-		$W \cdot m^{-2} \cdot sr^{-1}$
Blue light-small source	**B**(λ)	E_B	1.0*	-	1.0	-	400	-		$W \cdot m^{-2}$
* Small source defined as one with α < 0,011 radian. Averaging field of view at 10000 s is 0,1 radian.										

TPSI 毅豐光電股份有限公司 燈具實驗室
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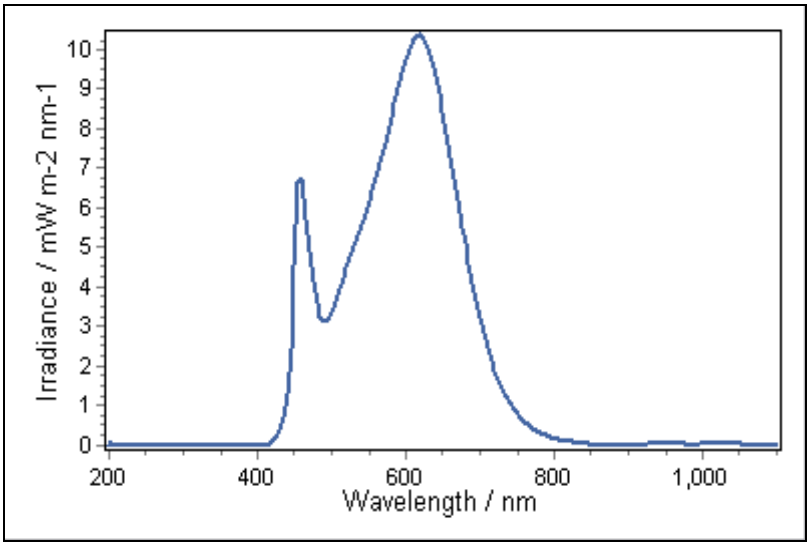
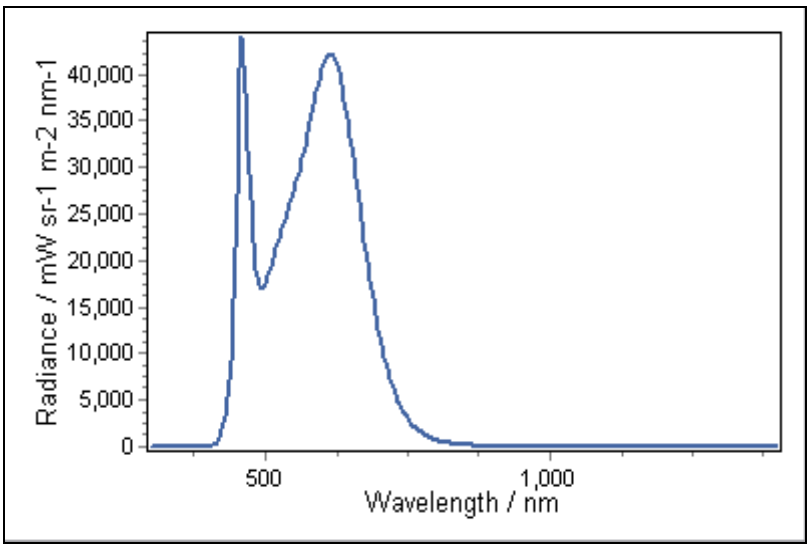
Test Result

spectral irradiance distribution



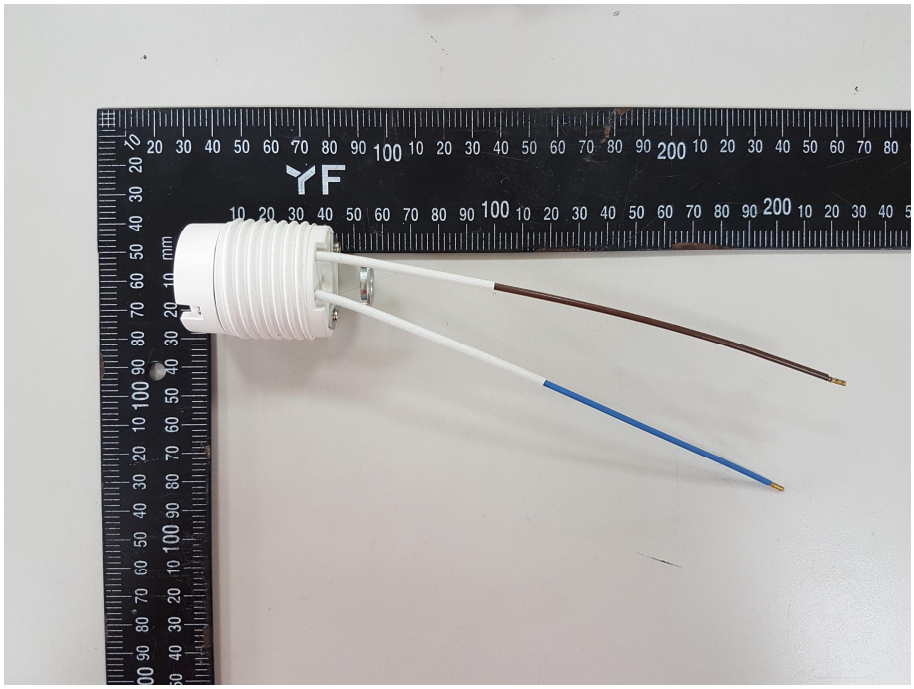
spectral radiance distribution



TPSI 毅豐光電股份有限公司 燈具實驗室
Taiwan Photometric Solution Inc
70953 台南市海中街 288 號 TEL：(06)2568831 FAX：(06)2563437
E-mail：light.lab@msa.hinet.net Web：www.lightlab.com.tw

Photograph of item

Test sample(light source)

Luminaire


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Equipment list for test

No.	Equipment No	Equipment	Manufacturer / Type / Series No
1	103T-13	Temperature and humidity records	TANDD(TR-72UI/F80417A2)
2	104E-26	Power Supply	BENTHAM/605/17048/10
3	104E-27	Power Supply	BENTHAM/706/17427/1
4	104O-32	Double-monochromator	BENTHAM/IDR300-PSL/17456
5	104O-33	Irradiance standard UV lamp	BENTHAM/CL7/17413
6	104O-34	Irradiance standard VIS-IR lamp	BENTHAM/CL6/16753/4
7	104O-35	Radiance standard lamp	BENTHAM/SRS12/17454/1
8	104O-36	Telescope	BENTHAM/TEL 309/16325/2
9	104O-37	CCD Camera	BENTHAM/PSL Profiler/17417
10	104O-38	Detector (luxmeter)	BENTHAM/DH400_VL/163364

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