

Photo optical safety of LEDs

**Photo biological safety test report
(IEC 62471:2006) & (IEC TR 62778:2014)**

SOLERIQ® S 12

OSRAM
Opto Semiconductors

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Further explanations:

Information: The information provided in this document consists of the list of individual LED types which are considered in the respective LED family.

Document: The document has the purpose to list the individual LED types which are considered in the respective LED family with respect to the photo optical safety.

Conditions: The photo optical safety tests according to IEC 62471:2006 have been conducted using the worst case LED type of the LED family. Therefore the less critical LED types are also grouped into the respective highest risk group determined by the worst case LED types.



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Test Report issued under the responsibility of:
NCB TÜV SÜD PSB Pte Ltd
1 Science Park Drive,
Singapore 118221



TEST REPORT IEC 62471 Photobiological safety of lamps and lamp systems	
Report Reference No.....:	7191246988-EEC20/01-CMF
Date of issue.....:	30 Oct 2020
Total number of pages	17
Name of Testing Laboratory preparing the Report.....:	TÜV SÜD PSB Pte Ltd
Applicant's name.....:	OSRAM Opto Semiconductors (M) Sdn. Bhd.
Address	Bayan Lepas Free Industrial Zone, Phase 1, 11900 Penang, Malaysia
Test specification:	
Standard	IEC 62471:2006
Test procedure	CB
Non-standard test method.....:	N/A
Test Report Form No.....:	IEC62471B
TRF Originator.....:	VDE Testing and Certification Institute
Master TRF	Dated 2018-08-16
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Test item description	LED Package	
Trade Mark	OSRAM	
Manufacturer	OSRAM Opto Semiconductors (M) Sdn. Bhd. Bayan Lepas Free Industrial Zone, Phase 1, 11900 Penang, Malaysia	
Model/Type reference	SOLERIQ® S 12 GW KAMLBA.CM	
Ratings	900mA (rated); 1610mA (max.)	
Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):		
<input checked="" type="checkbox"/>	CB Testing Laboratory:	TÜV SÜD PSB Pte Ltd
Testing location/ address	No. 1 Science Park Drive Singapore 118221	
Tested by (name, function, signature)	Chai Ming Fui, Associate Engineer	
Approved by (name, function, signature) . :	Derrick Sim, Product Manager	 Boon Hwa Derrick SIM
<input type="checkbox"/>	Testing procedure: CTF Stage 1:	
Testing location/ address		
Tested by (name, function, signature)		
Approved by (name, function, signature) . :		
<input type="checkbox"/>	Testing procedure: CTF Stage 2:	
Testing location/ address		
Tested by (name + signature)		
Witnessed by (name, function, signature) :		
Approved by (name, function, signature) . :		
<input type="checkbox"/>	Testing procedure: CTF Stage 3:	
<input type="checkbox"/>	Testing procedure: CTF Stage 4:	
Testing location/ address		
Tested by (name, function, signature)		
Witnessed by (name, function, signature) :		
Approved by (name, function, signature) . :		
Supervised by (name, function, signature):		

List of Attachments (including a total number of pages in each attachment):	
This test report contains a total of 17 pages, including appendix (page 17) which consist of: Appendix I : Photographs of the item tested and general view of test setup	
Summary of testing:	
Tests performed (name of test and test clause): All applicable tests were conducted	Testing location: No. 1 Science Park Drive Singapore 118221
Summary of compliance with National Differences (List of countries addressed): N/A	
<input checked="" type="checkbox"/> The product fulfils the requirements of IEC 62471 : 2006.	
Copy of marking plate: The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks. Nil	

Test item particulars:	
Tested lamp	<input checked="" type="checkbox"/> continuous wave lamps <input type="checkbox"/> pulsed lamps
Tested lamp system	N/A
Lamp classification group	<input type="checkbox"/> exempt <input type="checkbox"/> risk 1 <input checked="" type="checkbox"/> risk 2 <input type="checkbox"/> risk 3
Lamp cap	N/A
Bulb	N/A
Rated of the lamp	900mA (rated); 1610mA (max.)
Furthermore marking on the lamp	N/A
Seasoning of lamps according IEC standard	N/A
Used measurement instrument	In accordance to IEC 62471
Temperature by measurement	25°C (thermally stabilized)
Information for safety use	Risk Group 2 based on distance of 200mm for 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	: 26 Oct 2020
Date (s) of performance of tests	: 29 Oct 2020 to 30 Oct 2020
General remarks:	
"(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 <input type="checkbox"/> comma / <input checked="" type="checkbox"/> point is used as the decimal separator.	
Remark:	
i. Test was conducted at 900mA (rated) and 1610mA (max.) of CCT=5000K.	
ii. The item tested was found to be in conformity with IEC 62471 : 2006, and was classified under Risk Group 2 at 900mA rated current and 1610mA max. current respectively. Labelling and other information provision in accordance to IEC/TR 62471-2 shall be applied.	
Manufacturer's Declaration per sub-clause 4.2.5 of IEC60060-02:	
The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> Not applicable
When differences exist; they shall be identified in the General product information section.	
Name and address of factory (ies).....	: OSRAM Opto Semiconductors (M) Sdn. Bhd. Bayan Lepas Free Industrial Zone, Phase 1, 11900 Penang, Malaysia.
General product information and other remarks: -	

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict
4	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}	see clause 4.3	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, E_s , of the light source shall not exceed the levels defined by:		P
	$E_s \cdot t = \sum_{200}^{400} \sum_t E_\lambda(\lambda, t) \cdot S_{UV}(\lambda) \cdot \Delta t \cdot \Delta \lambda \leq 30 \text{ J m}^{-2}$		P
	The permissible time for exposure to ultraviolet radiation incident upon the unprotected eye or skin shall be computed by:		P
	$t_{\max} = \frac{30}{E_s} \text{ s}$		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 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} .		P
	The permissible time for exposure to ultraviolet radiation incident upon the unprotected eye for time less than 1000 s, shall be computed by:		P
	$t_{\max} \leq \frac{10000}{E_{UVA}} \text{ s}$		P
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

IEC 62471				
Clause	Requirement + Test	Result – Remark	Verdict	
	$L_B \cdot t = \sum_{300}^{700} \sum_t L_\lambda(\lambda, t) \cdot B(\lambda) \cdot \Delta\lambda \leq 10^6 \quad \text{J} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$	for $t \leq 10^4$ s	$t_{\max} = \frac{10^6}{L_B}$	N/A
	$L_B = \sum_{300}^{700} L_\lambda \cdot B(\lambda) \cdot \Delta\lambda \leq 100 \quad \text{W} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$	for $t > 10^4$ s		P
4.3.4	Retinal blue light hazard exposure limit - small source		N/A	
	Thus the spectral irradiance at the eye E_λ , weighted against the blue-light hazard function $B(\lambda)$ shall not exceed the levels defined by:	see table 4.2	N/A	
	$E_B \cdot t = \sum_{300}^{700} \sum_t E_\lambda(\lambda, t) \cdot B(\lambda) \cdot \Delta\lambda \leq 100 \quad \text{J} \cdot \text{m}^{-2}$	for $t \leq 100$ s	N/A	
	$E_B = \sum_{300}^{700} E_\lambda \cdot B(\lambda) \cdot \Delta\lambda \leq 1 \quad \text{W} \cdot \text{m}^{-2}$	for $t > 100$ s	N/A	
4.3.5	Retinal thermal hazard exposure limit		P	
	To protect against retinal thermal injury, the integrated spectral radiance of the light source, L_λ , weighted by the burn hazard weighting function $R(\lambda)$ (from Figure 4.2 and Table 4.2), i.e., the burn hazard weighted radiance, shall not exceed the levels defined by:		P	
	$L_R = \sum_{380}^{1400} L_\lambda \cdot R(\lambda) \cdot \Delta\lambda \leq \frac{50\,000}{\alpha \cdot t^{0.25}} \quad \text{W} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$	($10 \mu\text{s} \leq t \leq 10$ s)	P	
4.3.6	Retinal thermal hazard exposure limit – weak visual stimulus		N/A	
	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:		N/A	
	$L_{IR} = \sum_{780}^{1400} L_\lambda \cdot R(\lambda) \cdot \Delta\lambda \leq \frac{6\,000}{\alpha} \quad \text{W} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$	$t > 10$ s	N/A	
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, E_{IR} , over the wavelength range 780 nm to 3000 nm, for times less than 1000 s, shall not exceed:		P	
	$E_{IR} = \sum_{780}^{3000} E_\lambda \cdot \Delta\lambda \leq 18\,000 \cdot t^{-0.75} \quad \text{W} \cdot \text{m}^{-2}$	$t \leq 1000$ s	N/A	
	For times greater than 1000 s the limit becomes:		P	
	$E_{IR} = \sum_{780}^{3000} E_\lambda \cdot \Delta\lambda \leq 100 \quad \text{W} \cdot \text{m}^{-2}$	$t > 1000$ s	P	
4.3.8	Thermal hazard exposure limit for the skin		P	

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict
	Visible and infrared radiant exposure (380 nm to 3000 nm) of the skin shall be limited to:		P
	$E_{H,t} = \sum_{380}^{3000} \sum_i E_{\lambda}(\lambda, t) \cdot \Delta t \cdot \Delta \lambda \leq 20\,000 \cdot t^{0,25} \quad \text{J} \cdot \text{m}^{-2}$		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/A
	Seasoning of lamps shall be done as stated in the appropriate IEC lamp standard.		N/A
5.1.2	Test environment		P
	For specific test conditions, see the appropriate IEC 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
	– the appropriate IEC lamp standard, or		N/A
	– the manufacturer's recommendation		P
5.1.5	Lamp system operation		N/A
	The power source for operation of the test lamp shall be provided in accordance with:		N/A
	– the appropriate IEC standard, or		N/A
	– the manufacturer's recommendation		N/A
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

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict
	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/A
	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/A
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.		P
5.2.4	Pulse width measurement for pulsed sources		N/A
	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.		N/A
5.3	Analysis methods		P
5.3.1	Weighting curve interpolations		P
	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		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
	The quality of all measurement results must be quantified by an analysis of the uncertainty.	see Annex C in the norm	P
6	LAMP CLASSIFICATION		P
	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
6.1	Continuous wave lamps		P
6.1.1	Exempt Group		N/A
	In the exempt group are lamps, which does not pose any photobiological hazard. The requirement		N/A

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict
	is met by any lamp that does not pose:		
	– an actinic ultraviolet hazard (E_S) within 8-hours exposure (30000 s), nor		N/A
	– a near-UV hazard (E_{UVA}) within 1000 s, (about 16 min), nor		N/A
	– a retinal blue-light hazard (L_B) within 10000 s (about 2,8 h), nor		N/A
	– a retinal thermal hazard (L_R) within 10 s, nor		N/A
	– an infrared radiation hazard for the eye (E_{IR}) within 1000 s		N/A
6.1.2	Risk Group 1 (Low-Risk)		N/A
	In this group are lamps, which exceeds the limits for the except group but that does not pose:		N/A
	– an actinic ultraviolet hazard (E_S) within 10000 s, nor		N/A
	– a near ultraviolet hazard (E_{UVA}) within 300 s, nor		N/A
	– a retinal blue-light hazard (L_B) within 100 s, nor		N/A
	– a retinal thermal hazard (L_R) within 10 s, nor		N/A
	– an infrared radiation hazard for the eye (E_{IR}) within 100 s		N/A
	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.		N/A
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 (E_S) within 1000 s exposure, nor		P
	– a near ultraviolet hazard (E_{UVA}) within 100 s, nor		P
	– a retinal blue-light hazard (L_B) within 0,25 s (aversion response), nor		P
	– a retinal thermal hazard (L_R) within 0,25 s (aversion response), nor		P
	– an infrared radiation hazard for the eye (E_{IR}) within 10 s		P
	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.		P
6.1.4	Risk Group 3 (High-Risk)		N/A
	Lamps which exceed the limits for Risk Group 2 are in Group 3.		N/A
6.2	Pulsed lamps		N/A
	Pulse lamp criteria shall apply to a single pulse and to any group of pulses within 0,25 s.		N/A

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict
	A pulsed lamp shall be evaluated at the highest nominal energy loading as specified by the manufacturer.		N/A
	The risk group determination of the lamp being tested shall be made as follows:		N/A
	– a lamp that exceeds the exposure limit shall be classified as belonging to Risk Group 3 (High-Risk)		N/A
	– 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/A
	– 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/A

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict

Table 4.1	Spectral weighting function for assessing ultraviolet hazards for skin and eye			P
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.

IEC 62471			
Clause	Requirement + Test	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
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		$0,2 \cdot 10^{0,02(1150-\lambda)}$
1200-1400		0,02

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict

Table 5.4 Summary of the ELs for the surface of the skin or cornea (irradiance based values)					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} 100
Skin thermal	$E_H = \sum E_\lambda \cdot \Delta\lambda$	380 – 3000	< 10	2π sr	20000/t ^{0,75}

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 radiance $W \cdot m^{-2} \cdot sr^{-1}$
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 $0,0011 \cdot \sqrt{t}$ 0,1	$10^6/t$ $10^6/t$ $10^6/t$ 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

IEC 62471									
Clause	Requirement + Test				Result – Remark				Verdict
Table 6.1	Emission limits for risk groups of continuous wave lamps				Model: SOLERIQ® S 12 GW KAMLBA.CM (measured at 900mA)				P
Risk	Action spectrum	Symbol	Units	Emission Measurement					
				Exempt		Low risk		Mod risk	
				Limit	Result	Limit	Result	Limit	Result
Actinic UV	$S_{uv}(\lambda)$	E_s	$W \cdot m^{-2}$	0,001	0.000E+00	0,003	0.000E+00	0,03	0.000E+00
Near UV		E_{UVA}	$W \cdot m^{-2}$	10	1.143E-01	33	1.143E-01	100	1.143E-01
Blue light	$B(\lambda)$	L_B	$W \cdot m^{-2} \cdot sr^{-1}$	100	3.179E+03	10000	1.031E+04	400000	1.567E+04
Blue light, small source	$B(\lambda)$	E_B	$W \cdot m^{-2}$	1,0*	-	1,0	-	400	-
Retinal thermal	$R(\lambda)$	L_R	$W \cdot m^{-2} \cdot sr^{-1}$	28000/ α	1.415E+05	28000/ α	1.415E+05	71000/ α	2.150E+05
Retinal thermal, weak visual stimulus**	$R(\lambda)$	L_{IR}	$W \cdot m^{-2} \cdot sr^{-1}$	6000/ α	6.026E+01	6000/ α	6.026E+01	6000/ α	6.026E+01
IR radiation, eye		E_{IR}	$W \cdot m^{-2}$	100	1.045E-01	570	1.045E-01	3200	1.045E-01
* Small source defined as one with $\alpha < 0,011$ radian. Averaging field of view at 10000 s is 0,1 radian.									
** Involves evaluation of non-GLS source									

IEC 62471		
Clause	Requirement + Test	Result – Remark
		Verdict

Risk	Action spectrum	Symbol	Units	Emission Measurement						Mod risk	Result
				Exempt		Low risk		Mod risk			
				Limit	Result	Limit	Result	Limit	Result		
Table 6.1	Emission limits for risk groups of continuous wave lamps			Model: SOLERIQ® S 12 GW KAMLBA:CM (measured at 1610mA)						P	
Actinic UV	$S_{UV}(\lambda)$	E_s	$W \cdot m^{-2}$	0,001	0.000E+00	0,003	0.000E+00	0,03	0.000E+00	0,03	0.000E+00
Near UV		E_{UVA}	$W \cdot m^{-2}$	10	1.935E-01	33	1.935E-01	100	1.935E-01	100	1.935E-01
Blue light	$B(\lambda)$	L_B	$W \cdot m^{-2} \cdot sr^{-1}$	100	5.524E+03	10000	1.747E+04	4000000	2.652E+04	4000000	2.652E+04
Blue light, small source	$B(\lambda)$	E_B	$W \cdot m^{-2}$	1,0*	-	1,0	-	400	-	400	-
Retinal thermal	$R(\lambda)$	L_R	$W \cdot m^{-2} \cdot sr^{-1}$	28000/ α	2.365E+05	28000/ α	2.365E+05	71000/ α	3.590E+05	71000/ α	3.590E+05
Retinal thermal, weak visual stimulus**	$R(\lambda)$	L_{IR}	$W \cdot m^{-2} \cdot sr^{-1}$	6000/ α	1.119E+02	6000/ α	1.119E+02	6000/ α	1.119E+02	6000/ α	1.119E+02
IR radiation, eye		E_{IR}	$W \cdot m^{-2}$	100	2.370E-01	570	2.370E-01	3200	2.370E-01	3200	2.370E-01

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

** Involves evaluation of non-GLS source

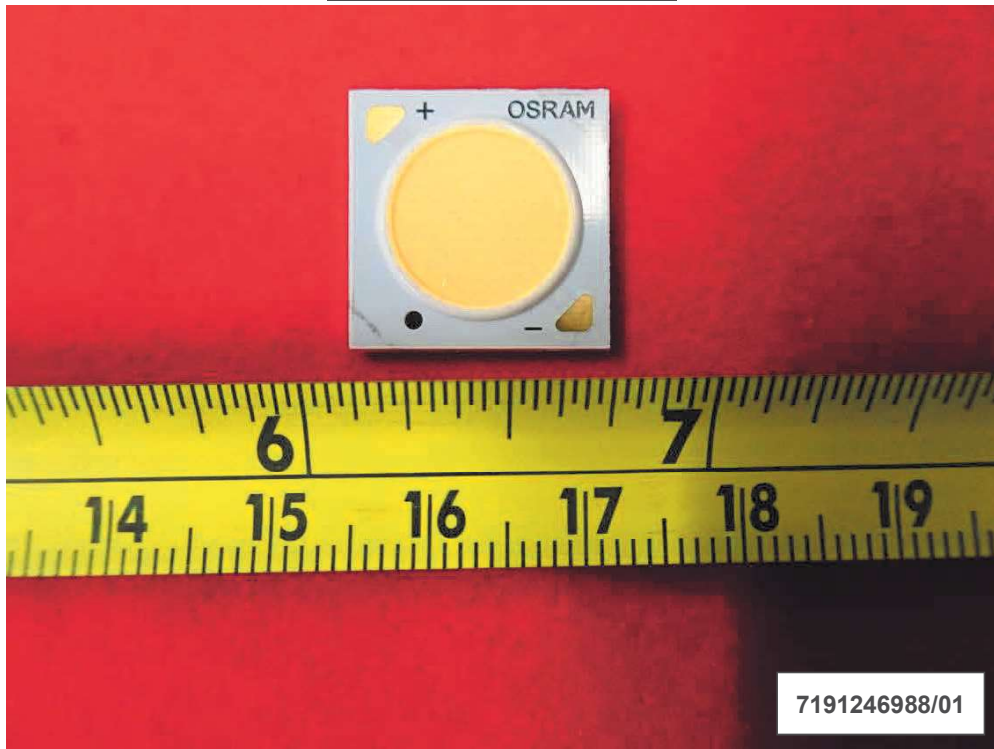
List of test equipment used:

A completed list of used test equipment shall be provided in the Test Reports when a Customer's Testing Facility according to CTF stage 1 or CTF stage 2 procedure has been used.

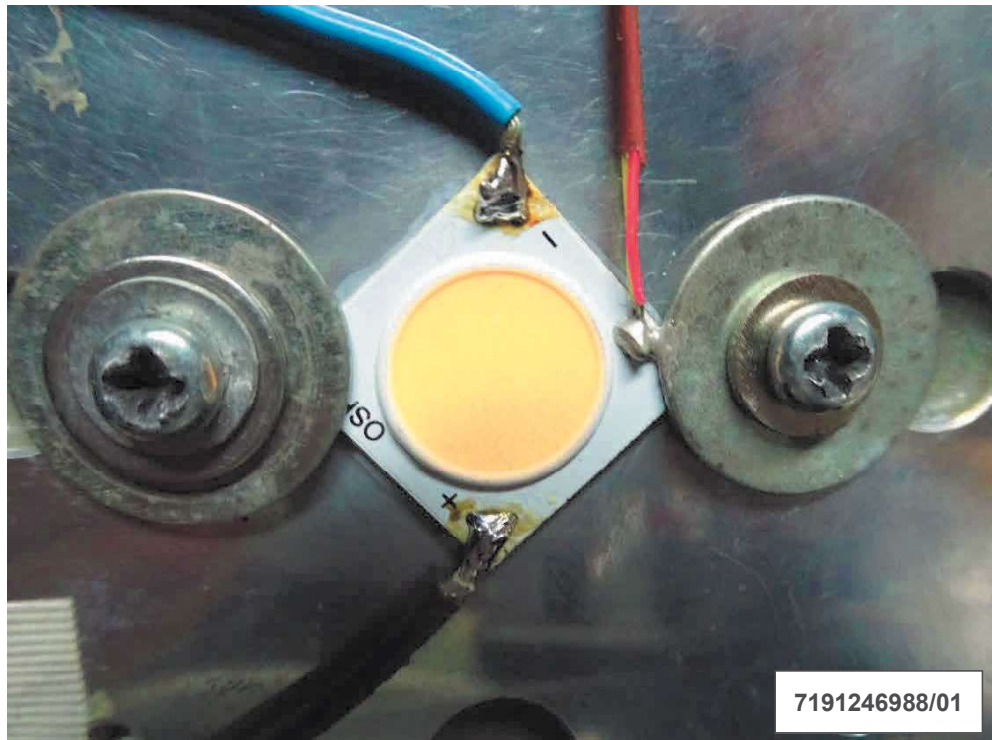
Note: This page may be removed when CTF stage 1 or CTF stage 2 are not used. See also clause 4.8 in OD 2020 for more details.

Clause	Measurement / testing	Testing / measuring equipment / material used, (Equipment ID)	Range used	Last Calibration date	Calibration due date
4	Electrical values	Digital Power Meter; s/n: 91F251447	N/A	17 Sep 2020	17 Oct 2021
4	Electrical values	Programmable DC Power Supply; s/n: 62150EF00275	N/A	12 Jun 2020	12 Jun 2021
4	Spectral radiance and irradiance	CCD camera and lens, and spectroradiometer; id: SUV50100906xx	N/A	Cal before use	Cal before use
4	Spectral radiance	36V 400W Standard lamp; s/n: LSD3640001	300-800nm	3 Apr 2020	3 Apr 2021
4	Spectral irradiance	Deuterium lamp; s/n: DL1008029	200-400nm	3 Apr 2020	3 Apr 2021
4	Spectral irradiance	230V 300W Standard lamp; s/n: LSD1003030	350-800nm	3 Apr 2020	3 Apr 2021
4	Illuminance	Lux Meter; s/n: ZD1601025	N/A	28 Aug 2019	28 Aug 2021

Appendix I
General view of tested sample



General view of test setup






Test Report issued under the responsibility of:
 NCB TÜV SÜD PSB Pte Ltd
 1 Science Park Drive,
 Singapore 118221



TEST REPORT IEC TR 62778 Application of IEC 62471 for the assessment of blue light hazard to light sources and luminaires	
Report Number	7191246988-EEC20/02-CMF
Date of issue	30 Oct 2020
Total number of pages	12
Name of Testing Laboratory preparing the Report	TÜV SÜD PSB Pte Ltd
Applicant's name	OSRAM Opto Semiconductors (M) Sdn. Bhd.
Address	Bayan Lepas Free Industrial Zone, Phase 1, 11900 Penang, Malaysia
Test specification:	
Standard	IEC TR 62778:2014 (Second Edition)
Test procedure	CB Scheme
Non-standard test method	N/A
Test Report Form No.	IEC62778A
Test Report Form(s) Originator	TÜV SÜD Product Service GmbH
Master TRF	Dated 2016-02
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General disclaimer:	
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 CB Testing Laboratory. The authenticity of this Test Report and its contents can be verified by contacting the NCB, responsible for this Test Report.	

Test item description :	LED Package	
Trade Mark :	OSRAM	
Manufacturer :	OSRAM Opto Semiconductors (M) Sdn. Bhd. Bayan Lepas Free Industrial Zone, Phase 1, 11900 Penang, Malaysia	
Model/Type reference :	SOLERIQ® S 12 GW KAMLBA.CM	
Ratings :	900mA (rated); 1610mA (max.)	
Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):		
<input checked="" type="checkbox"/>	CB Testing Laboratory:	TÜV SÜD PSB Pte Ltd
	Testing location/ address:	No. 1 Science Park Drive Singapore 118221
<input type="checkbox"/>	Associated CB Testing Laboratory:	
	Testing location/ address:	
	Tested by (name, function, signature):	Chai Ming Fui, Associate Engineer 
	Approved by (name, function, signature) ...:	Derrick Sim, Product Manager  Boon Hwa Derrick SIM
<input type="checkbox"/>	Testing procedure: CTF Stage 1:	
	Testing location/ address:	
	Tested by (name, function, signature):	
	Approved by (name, function, signature) ...:	
<input type="checkbox"/>	Testing procedure: CTF Stage 2:	
	Testing location/ address:	
	Tested by (name + signature)	
	Witnessed by (name, function, signature) ..:	
	Approved by (name, function, signature) ...:	
<input type="checkbox"/>	Testing procedure: CTF Stage 3:	
<input type="checkbox"/>	Testing procedure: CTF Stage 4:	
	Testing location/ address:	
	Tested by (name, function, signature):	
	Witnessed by (name, function, signature) ..:	
	Approved by (name, function, signature) ...:	
	Supervised by (name, function, signature) :	

List of Attachments (including a total number of pages in each attachment):	
This test report contains a total of 12 pages, including appendices (pages 10 to 12) which consist of: Appendix I : Photographs of the item tested and general view of test setup Appendix II : Additional information	
Summary of testing:	
Tests performed (name of test and test clause): All applicable tests were conducted	Testing location: No. 1 Science Park Drive Singapore 118221
Summary of compliance with National Differences (List of countries addressed): -	
<input checked="" type="checkbox"/> The product fulfils the requirements of IEC TR 62778 : 2014.	
Copy of marking plate:	
The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.	
Nil	

Test item particulars:	
Product evaluated	<input checked="" type="checkbox"/> LED package <input type="checkbox"/> LED module <input type="checkbox"/> Lamp <input type="checkbox"/> Luminaire
Rated voltage (V).....	N/A
Rated current (mA).....	900mA (rated); 1610mA (max.)
Rated CCT (K)	N/A
Rated Luminance (Mcd/m ²).....	N/A
Component report data used	<input checked="" type="checkbox"/> Not applicable <input type="checkbox"/> LED package <input type="checkbox"/> LED module <input type="checkbox"/> Lamp Report number: N/A
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.....	26 Oct 2020
Date (s) of performance of tests	29 Oct 2020 to 30 Oct 2020
General remarks:	
<p>"(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report.</p> <p>Throughout this report a <input type="checkbox"/> comma / <input checked="" type="checkbox"/> point is used as the decimal separator.</p> <p>Remark: Test was conducted at 900mA (rated) and 1610mA (max.) of CCT=5000K.</p>	
Manufacturer's Declaration per sub-clause 4.2.5 of IEC62502:	
The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided.....	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> Not applicable
When differences exist; they shall be identified in the General product information section.	
Name and address of factory (ies).....	OSRAM Opto Semiconductors (M) Sdn. Bhd. Bayan Lepas Free Industrial Zone, Phase 1, 11900 Penang, Malaysia.
General product information: -	

IEC TR 62778			
Clause	Requirement + Test	Result - Remark	Verdict

7	MEASUREMENT INFORMATION FLOW		P
7.1	Basic flow		N/A
	'Law of conservation of luminance' applied		N/A
	Use of only true luminance/radiance values		N/A
	In case of luminaire: The light source is operated in the luminaire under similar conditions as when tested as a component		N/A
	In case E_{thr} value for RG2 was established the peak value was derived from angular light distribution		N/A
7.2	Conditions for the radiance measurement		P
	Standard condition applied (200mm distance, 0,011rad field of view)		P
	Non-standard condition applied		N/A
7.3	Special cases (I): Replacement by a lamp or LED module of another type		N/A
	Light source is a white light source		N/A
	Evaluation done based on highest luminance		N/A
	Evaluation done based on CCT value		N/A
7.4	Special cases (II): Arrays and clusters of primary light sources		N/A
	LED package is evaluated as	<input type="checkbox"/> RG0 unlimited <input type="checkbox"/> RG1 unlimited	N/A
	E_{thr} of LED package applies to array		N/A
8	RISK GROUP CLASSIFICATION		P
	Risk group achieved:		P
	-...Risk Group 0 unlimited		N/A
	-...Risk Group 1 unlimited		N/A
	- E_{thr} (lx) : Distance to reach RG1 (m) :	Tested at 900mA: 1638lx Tested at 900mA: 530mm min. Tested at 1610mA: 1562lx Tested at 1610mA: 1260mm min	P

IEC TR 62778			
Clause	Requirement + Test	Result - Remark	Verdict

TABLE: Spectroradiometric measurement					P
Measurement performed on:		<input checked="" type="checkbox"/> LED package <input type="checkbox"/> LED module <input type="checkbox"/> Lamp <input type="checkbox"/> Luminaire			
Model number		N/A			
Test voltage (V)		N/A 36.9 (measured)			—
Test current (mA)		900 (rated)			—
Test frequency (Hz).....		DC			—
Ambient, t (°C)		25°C (thermally stabilized)			—
Measurement distance.....		<input checked="" type="checkbox"/> 20 cm <input type="checkbox"/> ... cm			—
Source size		<input checked="" type="checkbox"/> Non-small <input type="checkbox"/> Small : mm			—
Field of view		<input type="checkbox"/> 100 mrad <input checked="" type="checkbox"/> 11 mrad <input type="checkbox"/> 1,7 mrad (for small sources)			—
Item	Symbol	Units	Result	Remark	
Correlated colour temperature	CCT	K	4953		
x/y colour coordinates			0.3472/0.3602		
Blue light hazard radiance	L _B	W/(m ² •sr ¹)	10310	See Remark 1)	
Blue light hazard irradiance	E _B	W/m ²	N/A	See Remark 1)	
Luminance	L	cd/m ²	16890000		
Illuminance	E	lx	N/A	See Remark 1)	
Additional information:					
Peak wavelength		nm	450		
Blue light hazard radiance	L _B	W/(m ² •sr ¹)	3179	At 100mrad (20mm source size)	
Luminance	L	cd/m ²	5206000	At 100mrad (20mm source size)	
Blue light hazard radiance	L _B	W/(m ² •sr ¹)	15670	At 1.7mrad (0.34mm source size)	
Luminance	L	cd/m ²	25660000	At 1.7mrad (0.34mm source size)	
Supplementary information:					
1) Test was performed in accordance to clause 5.2.2.1 Standard radiance measurement method of IEC 62471:2006 (First edition).					

IEC TR 62778			
Clause	Requirement + Test	Result - Remark	Verdict

TABLE: Spectroradiometric measurement			P	
Measurement performed on:	<input checked="" type="checkbox"/> LED package <input type="checkbox"/> LED module <input type="checkbox"/> Lamp <input type="checkbox"/> Luminaire			
Model number	N/A			
Test voltage (V)	N/A 40.5 (measured)		—	
Test current (mA)	1610 (max.)		—	
Test frequency (Hz).....	DC		—	
Ambient, t (°C)	25°C (thermally stabilized)		—	
Measurement distance.....	<input checked="" type="checkbox"/> 20 cm <input type="checkbox"/> ... cm		—	
Source size	<input checked="" type="checkbox"/> Non-small <input type="checkbox"/> Small : mm		—	
Field of view	<input type="checkbox"/> 100 mrad <input checked="" type="checkbox"/> 11 mrad <input type="checkbox"/> 1,7 mrad (for small sources)		—	
Item	Symbol	Units	Result	Remark
Correlated colour temperature	CCT	K	5030	
x/y colour coordinates			0.3447/0.3553	
Blue light hazard radiance	L _B	W/(m ² •sr ¹)	17470	See Remark 1)
Blue light hazard irradiance	E _B	W/m ²	N/A	See Remark 1)
Luminance	L	cd/m ²	27290000	
Illuminance	E	lx	N/A	See Remark 1)
Additional information:				
Peak wavelength		nm	450	
Blue light hazard radiance	L _B	W/(m ² •sr ¹)	5524	At 100mrad (20mm source size)
Luminance	L	cd/m ²	8628000	At 100mrad (20mm source size)
Blue light hazard radiance	L _B	W/(m ² •sr ¹)	26520	At 1.7mrad (0.34mm source size)
Luminance	L	cd/m ²	41430000	At 1.7mrad (0.34mm source size)
Supplementary information:				
1) Test was performed in accordance to clause 5.2.2.1 Standard radiance measurement method of IEC 62471:2006 (First edition).				

IEC TR 62778			
Clause	Requirement + Test	Result - Remark	Verdict

	TABLE: Angular light distribution		N/A

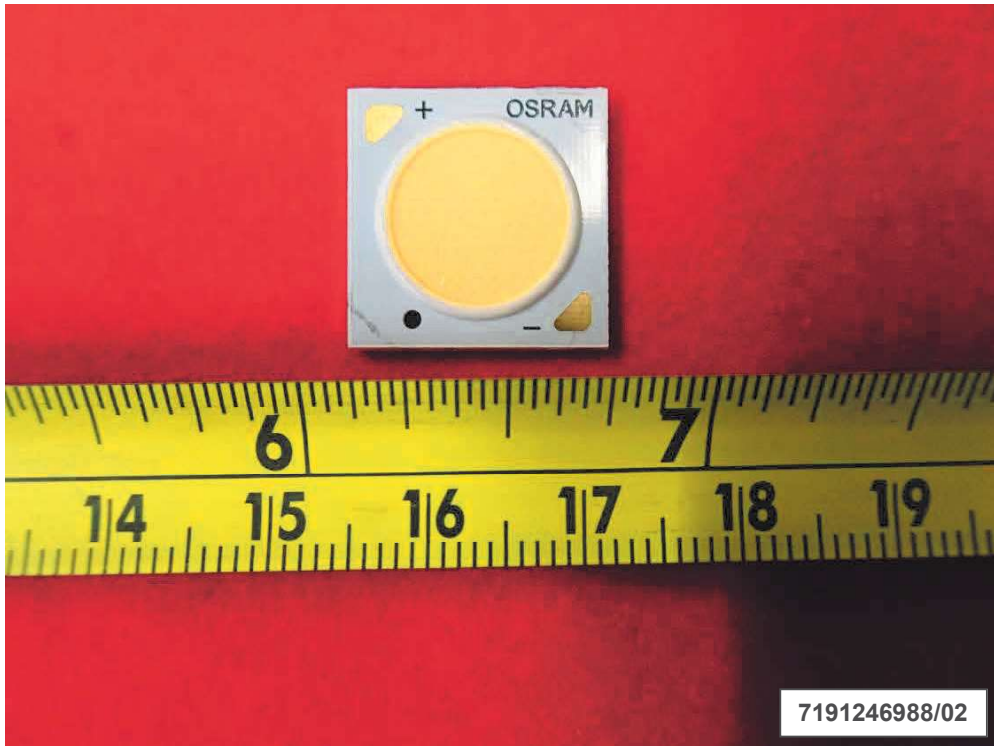
List of test equipment used:

A completed list of used test equipment shall be provided in the Test Reports when a Manufacturer Testing Laboratory according to CTF stage 1 or CTF stage 2 procedure has been used.

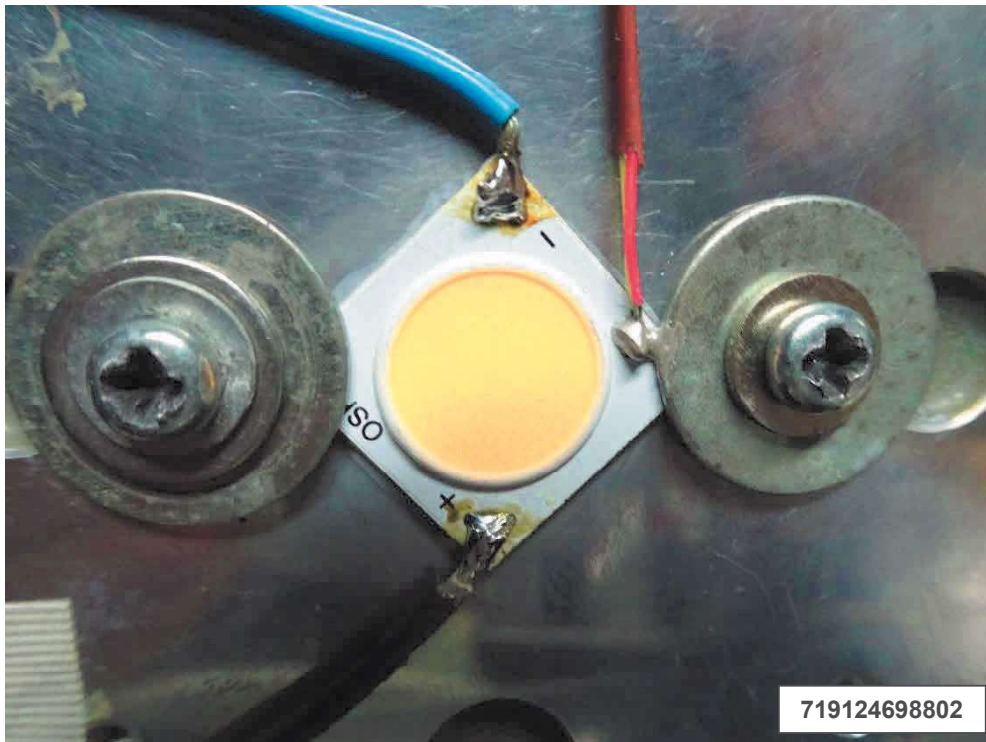
Note: This page may be removed when CTF stage 1 CTF stage 2 are not used. See also clause 4.8 in OD 2020 for more details.

Clause	Measurement / testing	Testing / measuring equipment / material used, (Equipment ID)	Range used	Last Calibration date	Calibration due date
7	Electrical values	Digital Power Meter; s/n: 91F251447	N/A	17 Sep 2020	17 Oct 2021
7	Electrical values	Programmable DC Power Supply; s/n: 62150EF00275	N/A	12 Jun 2020	12 Jun 2021
7	Spectral radiance	CCD camera and lens, and spectroradiometer; id: SUV50100906xx	N/A	Cal before use	Cal before use
7	Spectral radiance	36V 400W Standard lamp; s/n: LSD3640001	300-800nm	3 Apr 2020	3 Apr 2021
7	Illuminance	Lux Meter; s/n: ZD1601025	N/A	28 Aug 2019	28 Aug 2021

Appendix I
General view of tested sample

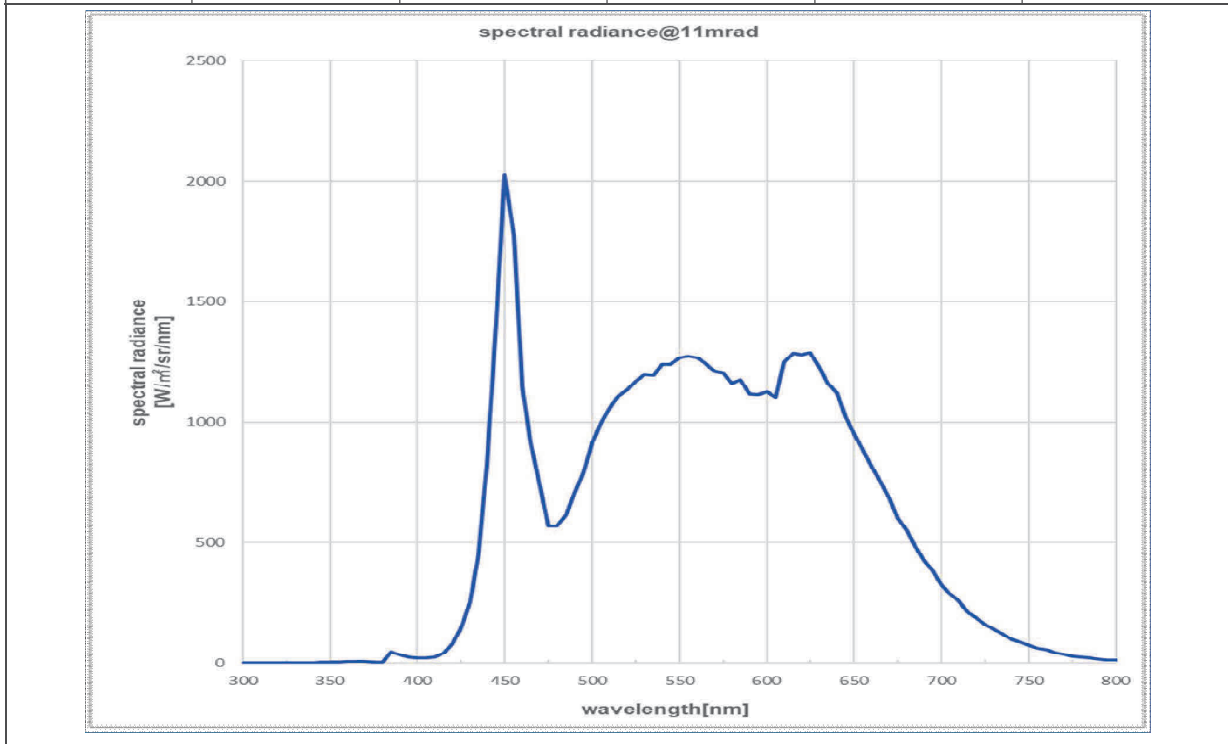


General view of test setup



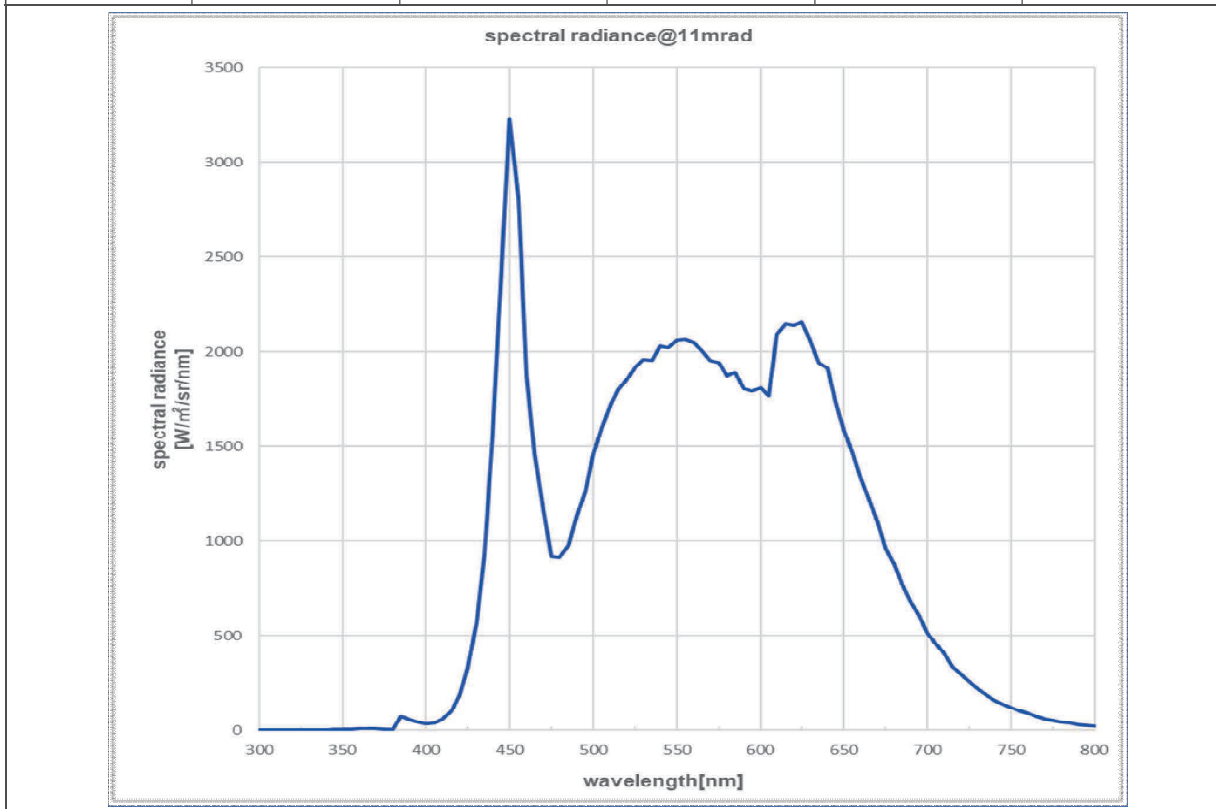
Appendix II
Additional information

Measured LED voltage (VDC)		36.9						
Test current (mA)		900						
Measured system power (W)		33.3						
Ambient temperature (°C)		25 (thermally stabilized)						
Burning position		Refer to test setup on Appendix I						
Peak wavelength		450						
Risk	Symbol	Units	Limit	Result	Limit	Result	Limit	Result
Blue light	L _B	W•m ⁻² •sr ⁻¹	100	3179	10000	10310	4000000	15670
Risk group classification.....:			RG0		RG1		RG2	
			<input type="checkbox"/>		<input type="checkbox"/>		<input checked="" type="checkbox"/>	
Field of view (mrad)	Distance (mm)	Diameter (mm)	Luminance (cd/m ²)	Blue light, L _B (W•m ⁻² •sr ⁻¹)	Exposure limit, t _{max} (mins)			
1.7	200	0.34	25660000	15670	1.1			
11	200	2.2	16890000	10310	1.6			
100	200	20	5206000	3179	5.2			



Appendix II – Cont'd
Additional information

Measured LED voltage (VDC)		40.5						
Test current (mA)		1610						
Measured system power (W)		65.2						
Ambient temperature (°C)		25 (thermally stabilized)						
Burning position		Refer to test setup on Appendix I						
Peak wavelength		450						
Risk	Symbol	Units	Limit	Result	Limit	Result	Limit	Result
Blue light	L _B	W•m ⁻² •sr ⁻¹	100	5524	10000	17470	4000000	26520
Risk group classification.....:			RG0		RG1		RG2	
			<input type="checkbox"/>		<input type="checkbox"/>		<input checked="" type="checkbox"/>	
Field of view (mrad)	Distance (mm)	Diameter (mm)	Luminance (cd/m ²)		Blue light, L _B (W•m ⁻² •sr ⁻¹)		Exposure limit, t _{max} (mins)	
1.7	200	0.34	41430000		26520		0.6	
11	200	2.2	27290000		17470		1.0	
100	200	20	8628000		5524		3.0	



LED Family: SOLERIQ® S 12

Corresponding photo biological safety report:
7191246988

LED	Test Status	Current	IEC 62471:2006	IEC TR 62778:2014
		900mA	RG2	Ethr=1638lx or 530mm
GW KAMLBA.CM	Test device	1610mA	RG2	Ethr=1562lx or 1260mm
	Covered		RG2	Ethr=1638lx or 530mm
GW KAMJBA.CM	device	-	RG2	Ethr=1562lx or 1260mm
	Covered		RG2	Ethr=1638lx or 530mm
GW KADEBA.CM	device	-	RG2	Ethr=1562lx or 1260mm
	Covered		RG2	Ethr=1638lx or 530mm
GW KAFFBA.CM	device	-	RG2	Ethr=1562lx or 1260mm
	Covered		RG2	Ethr=1638lx or 530mm
GW KAFHBA.CM	device	-	RG2	Ethr=1562lx or 1260mm
	Covered		RG2	Ethr=1638lx or 530mm
GW CAMLBA.EM	device	-	RG2	Ethr=1562lx or 1260mm

This Risk group assessment shall only be used in combination with the eye safety report according to IEC 62471:2006.

END OF DOCUMENT