Test Report issued under the responsibility of:

DEKRA

TEST REPORT
IEC TR 62778
Application of IEC 62471 for the assessment of blue light hazard to light sources and luminaires

Report Number. ..... :	6020516.50P
Date of issue ..... :	2017-11-15
Total number of pages ..... :	17
Name of Testing Laboratory preparing the Report ..... :	DEKRA Testing and Certification (Shanghai) Ltd. 3/F, #250, Jiangchangsan Road building 16 Headquater Economy Park Shibei Hi-Tech Park, Zhabei District, Shanghai, P.R.C 200436
Applicant's name ..... :	Lumileds Malaysia Sdn. Bhd.
Address ..... :	Lebuh Kampung Jawa Bayan Lepas FIZ, Phase 3 11900 Penang, Malaysia
Test specification:	
Standard ..... :	IEC TR 62778:2014 (Second Edition)
Test procedure ..... :	Type Test
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

If this Test Report Form is used by non-IECEE members, the IECEE/IEC logo and the reference to the CB Scheme procedure shall be removed.

This report is not valid as a CB Test Report unless signed by an approved CB Testing Laboratory and appended to a CB Test Certificate issued by an NCB in accordance with IECEE 02.

General disclaimer:

The test results presented in this report relate only to the object tested.
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Test item description ..... :	LED chip
Trade Mark ..... :	LUMILEDS
Manufacturer ..... :	Lumileds Malaysia Sdn. Bhd. Lebuh Kampung Jawa Bayan Lepas FIZ, Phase 3 11900 Penang, Malaysia
Model/Type reference ..... :	LUXEON 3535L HE Plus series Detailed lists refer to Appendix 2: Model List
Ratings ..... :	Max. 3,1Vdc, Max. 300mA Detailed information please refer to Appendix 2: Model List.

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):			
☒	**CB Testing Laboratory:**	DEKRA Testing and Certification (Shanghai) Ltd.	
Testing location/ address ..... :		3/F, #250, Jiangchangsan Road building 16 Headquater Economy Park Shibei Hi-Tech Park, Zhabei District, Shanghai, P.R.C 200436	
☐	~~Associated CB Testing Laboratory:~~		
~~Testing location/ address ..... :~~			
Tested by (name, function, signature) ..... :		Yuelie Wu	
Approved by (name, function, signature)... :		Hanson Zhang	
☐	~~Testing procedure: CTF Stage 1:~~		
~~Testing location/ address ..... :~~			
~~Tested by (name, function, signature) ..... :~~			
~~Approved by (name, function, signature) ..... :~~			
☐	~~Testing procedure: CTF Stage 2:~~		
~~Testing location/ address ..... :~~			
~~Tested by (name + signature) ..... :~~			
~~Witnessed by (name, function, signature) ..... :~~			
~~Approved by (name, function, signature) ..... :~~			
☐	~~Testing procedure: CTF Stage 3:~~		
☐	~~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):

- Appendix 1: Photo Documentation
- Appendix 2: Model List
- Appendix 3: Relative Spectrum Of Tested Sample(s)
- Appendix 4: Table 6.1Based On IEC 62471:2006
- Appendix 5: Table 6.1 Based On EN62471:2008, Attachment To IEC 62471 European Group Differences And National Differences

Summary of testing:

Tests performed (name of test and test clause):	**Testing location:**
These tests fulfil the requirements of standard ISO/IEC 17025. When determining the test conclusion, the Measurement Uncertainty of test has been considered. The tested sample of L135-6580CA35000P1 from LUXEON 3535L HE Plus series list at appendix 2 Have been tested according to the IEC 62471(first edition, 2006-07) **at 200mm** and been classified as **RG 2.** Have been tested according to the EN 62471:2008**at 200mm** and been classified as **RG 2.** Have been tested according to the IEC/TR62778:2014 and been classified as **RG 2 Unlimited for blue light hazard**.	DEKRA Testing and Certification (Shanghai) Ltd. 3/F, #250, Jiangchangsan Road building 16 Headquater Economy Park Shibei Hi-Tech Park, Zhabei District, Shanghai, P.R.C 200436

Summary of compliance with National Differences (List of countries addressed):EN Standards

EN 62471:2008

☒ **The product fulfils the requirements**

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.

N/A

Test item particulars.....:	**See below**
Product evaluated.....:	☒ **LED package** ☐ **LED module** ☐ **Lamp** ☐ **Luminaire**
Rated voltage (V) .....:	Max. 3,1Vdc
Rated current (mA) .....:	Max. 300mA
Rated CCT (K).....:	2700K / 3000K / 3500K / 4000K / 5000K / 5700K / 6500K Details information please refer to Appendix 2: Model List.
Rated Luminance (Mcd/m^2) .....:	--
Component report data used .....:	☒ **Not applicable** ☐ **LED package** ☐ **LED module** ☐ **Lamp** Report number: --
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 .....:	2017-11-15
Date (s) of performance of tests.....:	2017-11-15

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 ☒ comma / ☐ point is used as the decimal separator.

The product complied with the following standards:

☒IEC 62471:2006
☒EN 62471:2008
☐IEC/TR 62471-2:2009
☒IEC/TR 62778:2014

Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:

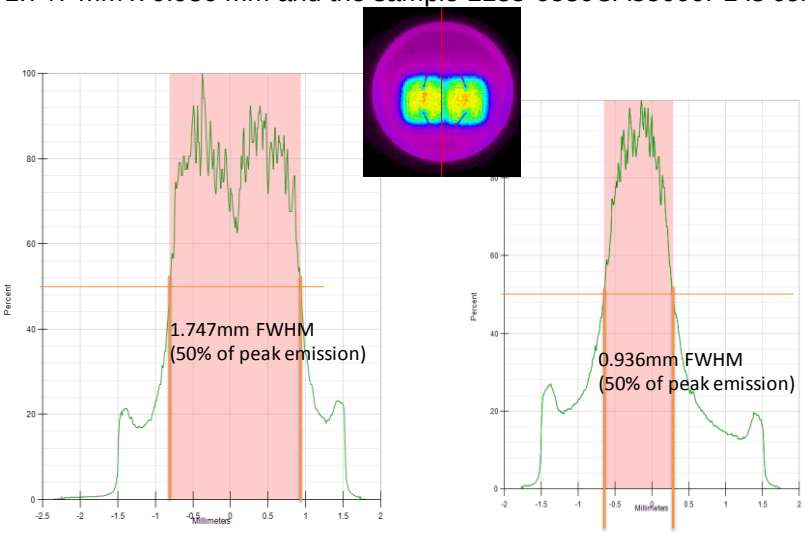
The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided ..... :	☐ **Yes** ☒**Not applicable**

When differences exist; they shall be identified in the General product information section.

Name and address of factory (ies) ..... : Lumileds Malaysia Sdn. Bhd.
Lebuh Kampung Jawa Bayan Lepas FIZ, Phase 3
11900 Penang, Malaysia

General product information:

The pink shaded area is the 50% of the max emission point. The diameter for the source size is therefore 1.747 mm x 0.936 mm and the sample L135-6580CA35000P1 is considered small source.



L135-6580CA35000P1, with ANSI bin 6500K, is part of the product family LUXEON 3535L HE Plus. The sample measured, L135-6580CA35000P1 was the highest CCT in the product family. The present classification is thus valid (worst case) for all LUXEON 3535L HE Plus products with part number L135-AABB-CA35000P1 and L135-AABB-SA35000P1 where AA is the CCT bins can be equal to 6500K or lower and BB is the CRI can be 70-90 (see TR IEC62778)". See appendix below for an explanation of the type of designation.

The products considered as worst case which should be evaluated at 200mm.

The sample of L135-6580CA35000P1 was tested at 200mm from the light source. CCT of spectral irradiance was found at 6775 K.

Base on the Model list which listed on the appendix 2, The tested sample can be considered as
☐ typical product ☒ worst product
Which the results can be reference used for the other models.

Type test was performed according to IEC 62471:2006 procedure.

IEC TR 62778			
Clause	Requirement + Test	Result - Remark	Verdict

7	**MEASUREMENT INFORMATION FLOW**		**P**
7.1	**Basic flow**		**P**
	'Law of conservation of luminance' applied		N/A
	Use of only true luminance/radiance values		P
	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 ..... :	☐RG0 unlimited ☐ RG1 unlimited	N/A
	E_{thr} of LED package applies to array		N/A
8	**RISC 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) ::	Refer to the Supplementary information of each **TABLE:Spectroradiometric measurement** as following	P

IEC TR 62778			
Clause	Requirement + Test	Result - Remark	Verdict

	TABLE:Spectroradiometric measurement		
	Measurement performed on:	☒ **LED package** ☐ **LED module** ☐ **Lamp** ☐ **Luminaire**	
	Model number	L135-6580CA35000P1	
	Test voltage (V)	3,1 Vdc	—
	Test current (mA)	300 mA	—
	Test frequency (Hz)	--	—
	Ambient, t(°C)	25**°C**	—
	Measurement distance	☒ 20 cm ☐ ... cm	—
	Source size	☐ Non-small ☒ Small : 1.747 mm x 0.936 mm	—
	Field of view	☐ 100 mrad ☒ 11 mrad ☐ 1,7 mrad (for small sources)	—

Item	Symbol	Units	Result	Remark
Correlated colour temperature	CCT	K	6775	
x/y colour coordinates			0,3079/ 0,3284	
Blue light hazard radiance	L_B	$W/(m^2 \cdot sr^1)$	--	@11mrad
Blue light hazard irradiance	E_B	W/m^2	1,06E+00	
Luminance	L	cd/m^2	9,41E+06	@11mrad
Illuminance	E	lx	1,20E+03	

Supplementary information:
Per IEC/TR 62778:2014:
E_{thr} = 1128 lx
D_{min} = 206 mm

IEC TR 62778			
Clause	Requirement + Test	Result - Remark	Verdict

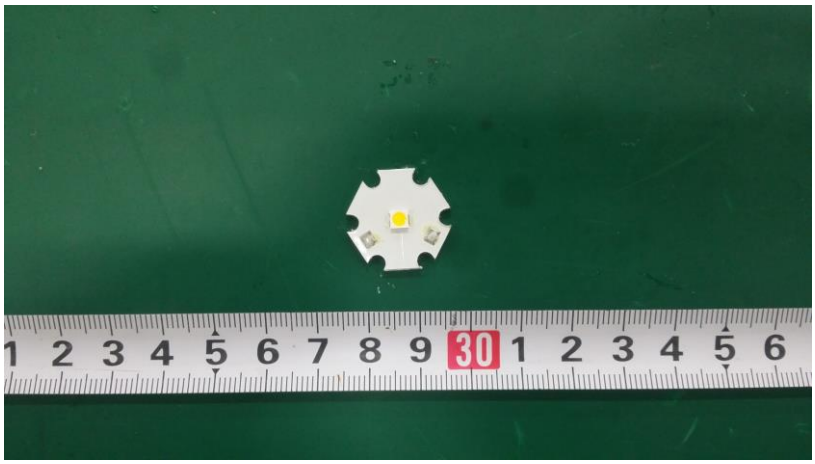
	TABLE: Angular light distribution	**N/A**

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	Irradiance measurements Radiance measurements	IDR 300 Monochromator (SH 344)	200-3000nm	/	/
7	Radiance measurements	S009 Telescope (SH 345)	300-1400nm	/	/
7	Radiance measurements	SRS 12 Radiance Standard (SH 348)	300-1400nm	2017/4/25	2018/4/25
7	Irradiance measurements	CL6 Spectral irradiance standard (SH 350)	300-3000nm	2017/4/25	2018/4/25
7	Irradiance measurements	CL7 Spectral irradiance standard (SH 351)	200-400nm	2017/4/25	2018/4/25
7	Irradiance measurements	Photometric detector head (SH 359)	380nm-800nm	2017/4/25	2018/4/25
7	Irradiance measurements Radiance measurements	Wattmeter (SH070)	500V,40A	2017/10/09	2018/10/09

Appendix 1: Photo Documentation



Overview (tested)

Appendix 2: Model List:

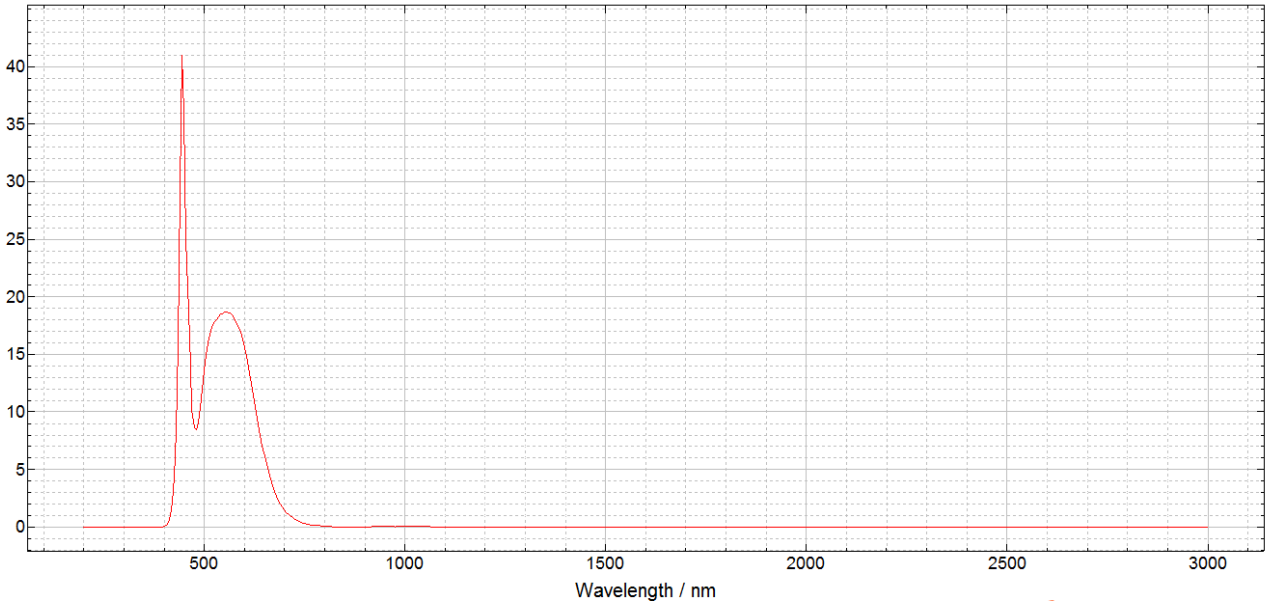
L135-6580CA35000P1, with ANSI bin 6500K, is part of the product family LUXEON 3535L HE Plus. The sample measured, L135-6580CA35000P1 was the highest CCT in the product family. The present classification is thus valid (worst case) for all LUXEON 3535L HE Plus products with part number L135-AABB-CA35000P1 and L135-AABB-SA35000P1 where AA is the CCT bins can be equal to 6500K or lower and BB is the CRI can be 70-90 (see TR IEC62778)". See appendix below for an explanation of the type of designation.

L135-AABBCC3500P1
Where
AA designates nominal ANSI CCT (27=2700K, 30=3000K, 35=3500K, 40=4000K, 50=5000KM 57=5700K, 65=6500K)
BB designates minimum CRI (70=70CRI, 80=80CRI, 90=90CRI)
CC designates options for lead frame (CA=Round Light Emitting Surface (LES), SA=Square LES)

Part number	CRI	CCT (K)	LED Junction Temperature (˚C)	Max Voltage (V)	Max Current (mA)
L135-2780CA35000P1	80	2700	125	3.1	300
L135-3080CA35000P1	80	3000	125	3.1	300
L135-3580CA35000P1	80	3500	125	3.1	300
L135-4080CA35000P1	80	4000	125	3.1	300
L135-5080CA35000P1	80	5000	125	3.1	300
L135-5780CA35000P1	80	5700	125	3.1	300
L135-6580CA35000P1	80	6500	125	3.1	300
L135-2770CA35000P1	70	2700	125	3.1	300
L135-3070CA35000P1	70	3000	125	3.1	300
L135-3570CA35000P1	70	3500	125	3.1	300
L135-4070CA35000P1	70	4000	125	3.1	300
L135-5070CA35000P1	70	5000	125	3.1	300
L135-5770CA35000P1	70	5700	125	3.1	300
L135-6570CA35000P1	70	6500	125	3.1	300
L135-2790CA35000P1	90	2700	125	3.1	300
L135-3090CA35000P1	90	3000	125	3.1	300
L135-3590CA35000P1	90	3500	125	3.1	300
L135-4090CA35000P1	90	4000	125	3.1	300
L135-5090CA35000P1	90	5000	125	3.1	300
L135-5790CA35000P1	90	5700	125	3.1	300
L135-6590CA35000P1	90	6500	125	3.1	300
L135-2780SA35000P1	80	2700	125	3.1	300
L135-3080SA35000P1	80	3000	125	3.1	300
L135-3580SA35000P1	80	3500	125	3.1	300
L135-4080SA35000P1	80	4000	125	3.1	300
L135-5080SA35000P1	80	5000	125	3.1	300
L135-5780SA35000P1	80	5700	125	3.1	300
L135-6580SA35000P1	80	6500	125	3.1	300
L135-2770SA35000P1	70	2700	125	3.1	300

L135-3070SA35000P1	70	3000	125	3.1	300
L135-3570SA35000P1	70	3500	125	3.1	300
L135-4070SA35000P1	70	4000	125	3.1	300
L135-5070SA35000P1	70	5000	125	3.1	300
L135-5770SA35000P1	70	5700	125	3.1	300
L135-6570SA35000P1	70	6500	125	3.1	300
L135-2790SA35000P1	90	2700	125	3.1	300
L135-3090SA35000P1	90	3000	125	3.1	300
L135-3590SA35000P1	90	3500	125	3.1	300
L135-4090SA35000P1	90	4000	125	3.1	300
L135-5090SA35000P1	90	5000	125	3.1	300
L135-5790SA35000P1	90	5700	125	3.1	300
L135-6590SA35000P1	90	6500	125	3.1	300

Appendix 3: Relative Spectrum Of Tested Sample(s)



Appendix 4: Table 6.1 Based On IEC 62471:2006

DUT: L135-6580CA35000P1, Evaluation Distance: 200mm, Test current: 300mA, Angular subtense of the apparent source α: 6,7075mrad

IEC 62471			
Clause	Requirement + Test	Result – Remark	Verdict

Table 6.1	Emission limits for risk groups of continuous wave lamps									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	0,0000	0,003		0,03		
Near UV		E_{UVA}	$W \cdot m^{-2}$	10	0,0000	33		100		
Blue light	B(λ)	L_B	$W \cdot m^{-2} \cdot sr^{-1}$	100	--	10000		4000000		
Blue light, small source	B(λ)	E_B	$W \cdot m^{-2}$	1,0*	1,06E+00	1,0	1,06E+00	400	1,06E+00	
Retinal thermal	R(λ)	L_R	$W \cdot m^{-2} \cdot sr^{-1}$	28000/α	1,41E+05	28000/ α		71000/ α		
Retinal thermal, weak visual stimulus**	R(λ)	L_{IR}	$W \cdot m^{-2} \cdot sr^{-1}$	6000/α	--	6000/α		6000/α		
IR radiation, eye		E_{IR}	$W \cdot m^{-2}$	100	0,02	570		3200		

* Small source defined as one with α < 0,011 radian. Averaging field of view at 10000 s is 0,1 radian.
** Involves evaluation of non-GLS source

Appendix 5: Table 6.1 Based On EN62471:2008, Attachment To IEC 62471 European Group Differences And National Differences

DUT: L135-6580CA35000P1, Evaluation Distance: 200mm, Test current: 300mA, Angular subtense of the apparent source α: 6,7075mrad

EN 62471			
Clause	Requirement + Test	Result – Remark	Verdict

Table 6.1	Emission limits for risk groups of continuous wave lamps (based on EU Directive 2006/25/EC)									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	0,0000	--	--	--	--	
Near UV		E_{UVA}	$W \cdot m^{-2}$	0,33	0,0000	--	--	--	--	
Blue light	B(λ)	L_B	$W \cdot m^{-2} \cdot sr^{-1}$	100	--	10000		4000000		
Blue light, small source	B(λ)	E_B	$W \cdot m^{-2}$	0,01*	1,06E+00	1,0	1,06E+00	400	1,06E+00	
Retinal thermal	R(λ)	L_R	$W \cdot m^{-2} \cdot sr^{-1}$	28000/α	1,41E+05	28000/ α		71000/ α		
Retinal thermal, weak visual stimulus**	R(λ)	L_{IR}	$W \cdot m^{-2} \cdot sr^{-1}$	545000 0,0017≤ α ≤ 0,011	--					
				6000/α 0,011≤ α ≤ 0,1	--					
IR radiation, eye		E_{IR}	$W \cdot m^{-2}$	100	0,02	570		3200		

* Small source defined as one with α < 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 applicable aperture 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.