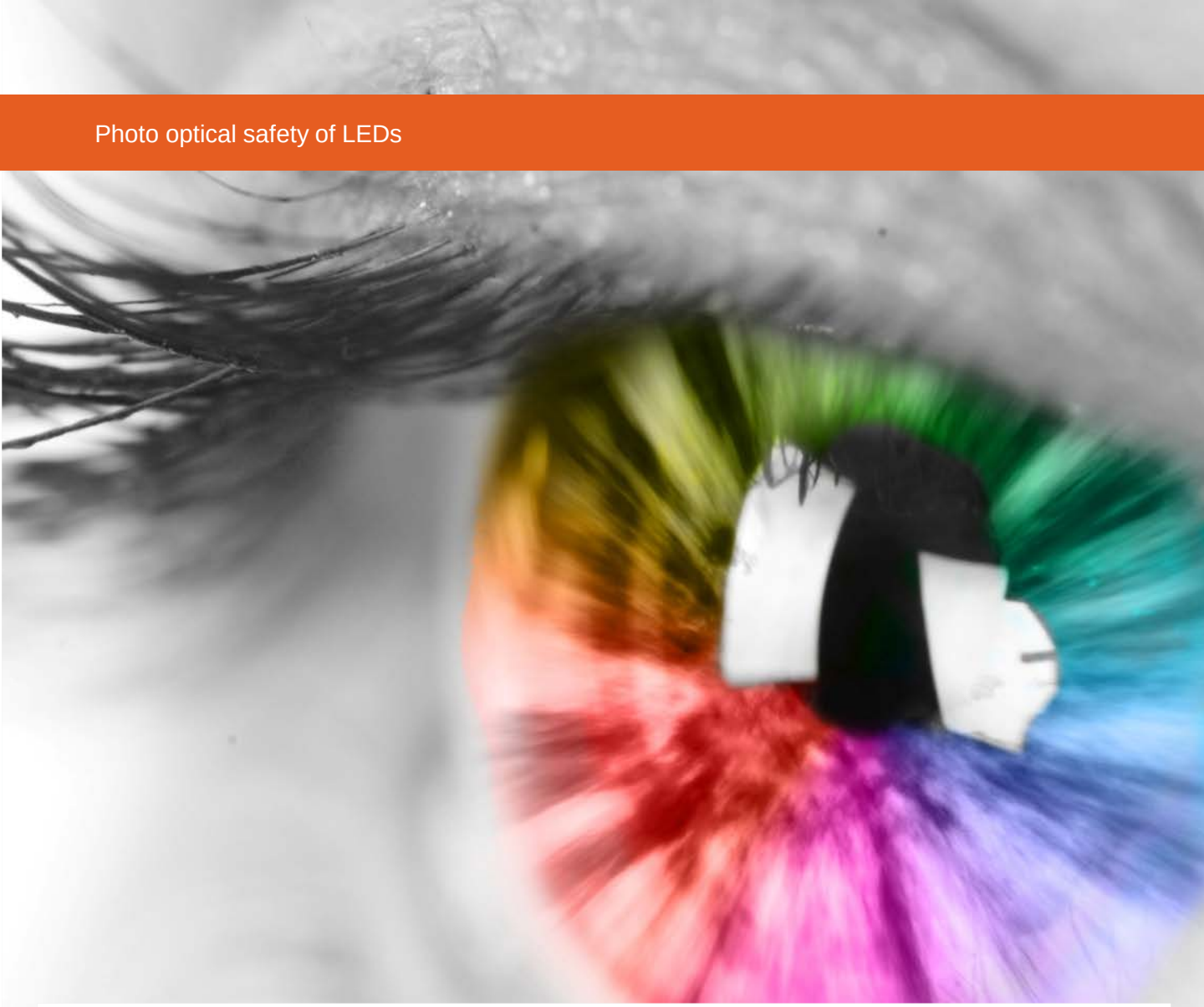

Photo biological safety test report (IEC 62471:2006)&(IEC TR 62778:2014)

DURIS E 2835

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 their 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.

Test Report issued under the responsibility of:

TEST REPORT
IEC 62471
Photobiological safety of lamps and lamp systems

Report Reference No.	:	216-16a
Date of issue	:	10. October 2016
Total number of pages	:	16
Testing Laboratory	:	**Central Laboratory for Light Measurements**
Address	:	OSRAM GmbH, CI ANM CLM Berliner Allee 65; 86153 Augsburg, Germany
Applicant's name	:	Yeap, Sang Yee Jacqueline OS SSL AE (SSL Application Engineering)
Address	:	OSRAM Opto Semiconductors (M) Sdn. Bhd. Bayan Lepas Free Industr. Zone Phase 1 - Pen 3 11900 Penang Malaysia
Test specification:		
Standard	:	IEC 62471:2006 (ed.1)
Test procedure	:	N/A
Non-standard test method	:	N/A
Test Report Form No.	:	IEC62471A
TRF Originator	:	**VDE** Testing and Certification Institute
Master TRF	:	Dated 2009-05

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.

Test item description	:	Duris E2835
Trade Mark	:	OSRAM
Manufacturer	:	OSRAM Opto Semiconductors
Model/Type reference	:	GW JTLRS1.EM
Ratings	:	150 mA DC (max. current) - 6500K (highest available CCT)

Testing procedure and testing location:	
☒ **Testing Laboratory:**	**Central Laboratory for Light Measurements**
Testing location/ address.....:	OSRAM GmbH, CI ANM CLM Berliner Allee 65; 86153 Augsburg, Germany
	DAkkS Deutsche Akkreditierungsstelle D-PL-17666-02-00
Tested by (name + signature) .....:	Axel Gurel
Approved by (+ signature).....:	Dr. Walter Steudtner
☐ Testing procedure: TMP	
Tested by (name + signature) .....:	
Approved by (+ signature).....:	
Testing location/ address.....:	
☐ Testing procedure: WMT	
Tested by (name + signature) .....:	
Witnessed by (+ signature).....:	
Approved by (+ signature).....:	
Testing location/ address.....:	
☐ Testing procedure: SMT	
Tested by (name + signature) .....:	
Approved by (+ signature).....:	
Supervised by (+ signature) .....:	
Testing location/ address..... :	
☐ Testing procedure: RMT	
Tested by (name + signature) .....:	
Approved by (+ signature).....:	
Supervised by (+ signature) .....:	
Testing location/ address.....:	

Summary of testing:

Tests performed (name of test and test clause):	**Testing location:**
Test was performed according to clause 5 MEASUREMENT OF LAMPS AND LAMP SYSTEMS of IEC 62471:2006 (ed.1) Test results: - Duris E2835 GW JTLRS1.EM: • **RG1, low risk**	**Central Laboratory for Light Measurements** OSRAM GmbH, CI ANM CLM Berliner Allee 65; 86153 Augsburg, Germany

Summary of compliance with National Differences:

Note: EN Group Differences together with National Differences and Special National Conditions, if any, are in the Appendix to the main body of this TRF.

Copy of marking plate / product picture:

Object no. e767 mounted on an OSRAM Duris S5 PCB.

The above label may show a draft of an artwork for making plate pending approval by National Certification Bodies and it shall not be affixed to products prior to such an approval.

Test item particulars ..... :	
Tested lamp ..... :	☒ continuous wave lamps ☐ pulsed lamps
Tested lamp system ..... :	Duris E2835 GW JTLRS1.EM
Lamp classification group ..... :	☐ exempt ☒ risk 1 ☐ risk 2 ☐ risk 3
Lamp cap ..... :	N/A
Bulb ..... :	N/A
Rated of the lamp ..... :	max. 150mA DC
Furthermore marking on the lamp ..... :	N/A
Seasoning of lamps according IEC standard ..... :	N/A
Used measurement instrument ..... :	See list of measurement equipment on page 15
Temperature by measurement ..... :	25°C +/- 2K
Information for safety use ..... :	RG1, low risk

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 ..... : 05.10.2016

Date (s) of performance of tests ..... : 06.10.2016

General remarks:

Explanatory statement:

The measurement was performed at maximum current in steady state. The measurement result for blue light hazard is L_B = 8,34 kW•m^{-2}•sr^{-1} at a distance of 200mm (measuring aperture 11mrad).

This report represents the highest available CCT and covers the whole product family.

(for detailed results see page 16)

This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.
"(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 is used as the decimal separator.
List of test equipment must be kept on file and available for review.

Note: EN Group Differences together with National Differences and Special National Conditions, if any, are in the Appendix to the main body of this TRF.

Factory (for information only)

Name ..... : OSRAM Opto Semiconductors

Address ..... : Penang, Malaysia

General product information:

UV- and IR radiation of visible LED products can be neglected!

IEC 62471			
Clause	Requirement – Test	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	*No relevant radiation emission below 400 nm (visible LED)*	*N/A*
	The exposure limit for effective radiant exposure is 30 J·m^{-2} within any 8-hour period		*N/A*
	To protect against injury of the eye or skin from ultraviolet radiation exposure produced by a broad-band source, the effective integrated spectral irradiance , E_S, of the light source shall not exceed the levels defined by:		*N/A*
	$E_s \cdot t = \sum_{200}^{400} \sum_{t} E_\lambda(\lambda,t) \cdot S_{UV}(\lambda) \cdot \Delta t \cdot \Delta\lambda \le 30$ J·m^{-2}		*N/A*
	The permissible time for exposure to ultraviolet radiation incident upon the unprotected eye or skin shall be computed by:		*N/A*
	$t_{max} = \frac{30}{E_s}$ s		*N/A*
4.3.2	Near-UV hazard exposure limit for eye		
	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}.	*No relevant radiation emission below 400 nm (visible LED)*	*N/A*
	The permissible time for exposure to ultraviolet radiation incident upon the unprotected eye for time less than 1000 s, shall be computed by:		*N/A*
	$t_{max} \le \frac{10\,000}{E_{UVA}}$ s		*N/A*
4.3.3	Retinal blue light hazard exposure limit		
	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:	*RG1*	*P*

IEC 62471			
Clause	Requirement – Test	Result – Remark	Verdict
	$L_B \cdot t = \sum_{300}^{700} \sum_{t} L_\lambda(\lambda,t) \cdot B(\lambda) \cdot \Delta t \cdot \Delta\lambda \le 10^6$ J · m^{-2} · sr^{-1}	for t ≤ 10^4 s	*P*
	$L_B = \sum_{300}^{700} L_\lambda \cdot B(\lambda) \cdot \Delta\lambda \le 100$ W · m^{-2} · sr^{-1}	for t > 10^4 s	*N/A*
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(λ) shall not exceed the levels defined by:	see table 4.2	
	$E_B \cdot t = \sum_{300}^{700} \sum_{t} E_\lambda(\lambda,t) \cdot B(\lambda) \cdot \Delta t \cdot \Delta\lambda \le 100$ J · m^{-2}	for t ≤ 100 s	*N/A*
	$E_B = \sum_{300}^{700} E_\lambda \cdot B(\lambda) \cdot \Delta\lambda \le 1$ W · m^{-2}	for t > 100 s	*N/A*
4.3.5	Retinal thermal hazard exposure limit		
	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:	*Permissible blue light exposure time larger than 10s => retinal thermal hazard can be neglected (IEC 62471, clause 3.4.)*	*N/A*
	$L_R = \sum_{380}^{1400} L_\lambda \cdot R(\lambda) \cdot \Delta\lambda \le \frac{50\,000}{\alpha \cdot t^{0,25}}$ W · m^{-2} · sr^{-1}	(10 µs ≤ t ≤ 10 s)	*N/A*
4.3.6	Retinal thermal hazard exposure limit – weak visual stimulus		
	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:	*No relevant radiation emission above 780 nm (visible LED)*	*N/A*
	$L_{IR} = \sum_{780}^{1400} L_\lambda \cdot R(\lambda) \cdot \Delta\lambda \le \frac{6\,000}{\alpha}$ W · m^{-2} · sr^{-1}	t > 10 s	*N/A*
4.3.7	Infrared radiation hazard exposure limits for the eye		
	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:	*No relevant radiation emission above 780 nm (visible LED)*	*N/A*
	$E_{IR} = \sum_{780}^{3\,000} E_\lambda \cdot \Delta\lambda \le 18\,000 \cdot t^{-0,75}$ W · m^{-2}	t ≤ 1000 s	*N/A*
	For times greater than 1000 s the limit becomes:		

IEC 62471			
Clause	Requirement – Test	Result – Remark	Verdict
	$E_{IR} = \sum_{780}^{3\,000} E_\lambda \cdot \Delta\lambda \le 100 \qquad W \cdot m^{-2}$	t > 1000 s	*N/A*
4.3.8	Thermal hazard exposure limit for the skin		
	Visible and infrared radiant exposure (380 nm to 3000 nm) of the skin shall be limited to:		
	$E_H \cdot t = \sum_{380}^{3\,000} \sum_{t} E_\lambda(\lambda,t) \cdot \Delta t \cdot \Delta\lambda \le 20\,000 \cdot t^{0,25} \qquad J \cdot m^{-2}$	*No relevant radiation emission to cause thermal hazard for the skin (visible LED)*	*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.	*No seasoning in appropriate LED module standards required*	*N/A*
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.	*Type test at 25°C +/-2K ambient temperature, according to LED module safety standard IEC 62031 Ed. 1 2008-01*	*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.	*The optical measurement set-up is placed in special black painted housing and shielded with baffles*	*P*
5.1.4	Lamp operation		
	Operation of the test lamp shall be provided in accordance with:		
	– the appropriate IEC lamp standard, or		*N/A*
	– 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		*N/A*
	– the manufacturer' s recommendation	*Operation at max. current*	*P*
5.2	Measurement procedure		
5.2.1	Irradiance measurements		
	Minimum aperture diameter 7mm.		*N/A*
	Maximum aperture diameter 50 mm.		*N/A*

IEC 62471			
Clause	Requirement – Test	Result – Remark	Verdict
	The measurement shall be made in that position of the beam giving the maximum reading.	*No irradiance measurements performed*	*N/A*
	The measurement instrument is adequate calibrated.		*N/A*
5.2.2	Radiance measurements		
5.2.2.1	Standard method		
	The measurements made with an optical system.	*see equipment list*	*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.		*N/A*
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.		*N/A*
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.		*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.	see Annex C in the norm	*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	

IEC 62471			
Clause	Requirement – Test	Result – Remark	Verdict
	– 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	*Object classification at a distance of 200mm*	*P*
6.1	Continuous wave lamps		
6.1.1	Except Group		
	In the except 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		*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)		
	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		*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		*P*
	– 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)		
	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		*N/A*
	– a near ultraviolet hazard (E_{UVA}) within 100 s, nor		*N/A*
	– a retinal blue-light hazard (L_B) within 0,25 s (aversion response), nor		*N/A*

IEC 62471			
Clause	Requirement – Test	Result – Remark	Verdict
	– a retinal thermal hazard (L_R) within 0,25 s (aversion response), nor		*N/A*
	– an infrared radiation hazard for the eye (E_{IR}) within 10 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 10 s are in Risk Group 2.		*N/A*
6.1.4	Risk Group 3 (High-Risk)		
	Lamps which exceeds the limits for Risk Group 2 are in Group 3.		*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.		*N/A*
	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:		
	– 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		

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	

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)				
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)				
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									
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	*N/A*	0,003	*N/A*	0,03	*N/A*	
Near UV		E_{UVA}	$W \cdot m^{-2}$	10	*N/A*	33	*N/A*	100	*N/A*	
Blue light	B(λ)	L_B	$W \cdot m^{-2} \cdot sr^{-1}$	100	*N/A*	10000	***8340***	4000000	*N/A*	
Blue light, small source	B(λ)	E_B	$W \cdot m^{-2}$	1,0*	*N/A*	1,0	*N/A*	400	*N/A*	
Retinal thermal	R(λ)	L_R	$W \cdot m^{-2} \cdot sr^{-1}$	28000/α	*N/A*	28000/α	*N/A*	71000/α	*N/A*	
Retinal thermal, weak visual stimulus**	R(λ)	L_{IR}	$W \cdot m^{-2} \cdot sr^{-1}$	6000/α	*N/A*	6000/α	*N/A*	6000/α	*N/A*	
IR radiation, eye		E_{IR}	$W \cdot m^{-2}$	100	*N/A*	570	*N/A*	3200	*N/A*	

* 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

Furthermore remarks:

- List of measurement equipment

Clause	Measurement / testing	Testing / measuring equipment / material used, (Equipment ID)	Range used	Last Calibration date	Calibration due date
	spectral irradiance	OSRAM HLX 64361 spectral irradiance tungsten halogen lamp serial no. 009		31.05.2016	31.05.2018
	spectral radiance	OSRAM Wi 17G spectral radiance tungsten ribbon lamp serial no. 30		28.06.2016	28.06.2018
	spectral radiance	Instrument Systems Compact Array Spectrometer - CAS 140 CT serial no. 44314208			*)
	spectral radiance	Instrument Systems Radiance setup - TOP 200 serial no. 01420108			*)
	spectral irradiance	Instrument Systems Compact Array Spectrometer - CAS 140 CT serial no. 1628142			*)
	spectral irradiance	Instrument Systems Irradiance setup - EOP 7mm entrance aperture serial no. 1628142E1			*)
	radiance / luminance	TechnoTeam Radiance camera – LMK serial no. DXM2141			*)
	electrical values	Digital-Multimeter Keithley 2000 no. 1110633		02.08.2016	02.08.2017
	electrical values	Digital-Multimeter Keithley 2000 no. 0947882		02.08.2016	02.08.2017
	electrical values	High Precision Shunt Resistor 100 mΩ Burster 1282 no. 412052		17.12.2015	15.12.2017
	ambient temperature	Vaisala SP-2000-20R serial no. 16142050		18.04.2016	18.04.2017
	distance	Gauge block Holex 200mm serial no. 6134		04.02.2016	04.02.2017

**) instruments calibrated by standard lamps (see above)*

All standard lamps are traceable to the German NMI: Physikalisch Technische Bundesanstalt

Central Laboratory for Light Measurements

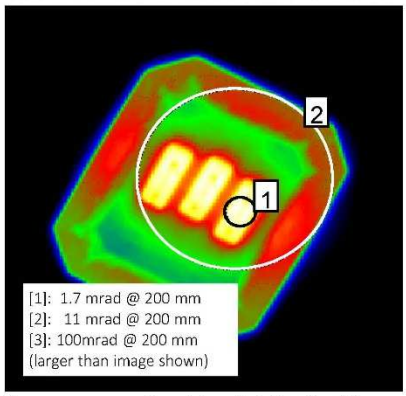
enclosure 1 to report **216-16a**

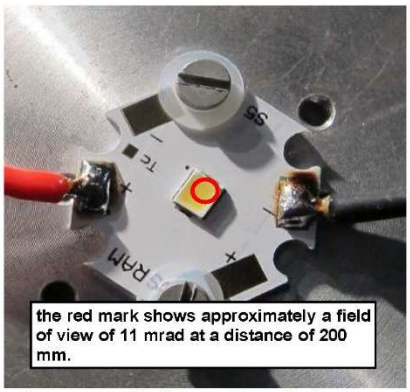
Blue Light / Retinal Thermal Hazard classification of **Duris E2835 GW JTLRS1 EM no. e767**

Test information and classification		
measured system voltage		9,92 V DC
measured current		0,15 A
measured system power		1,49 W
temperature 25°C		thermally stabilized
burning position		as depicted
CCT	(11 mrad @ 200mm)	9897 K
BLH	(11 mrad @ 200 mm)	**8,34 kW/(m²sr)**
BLH	(100 mrad @ 200mm)	**0,13 kW/(m²sr)**
emission limits according to EN 62471		
BLH emission limit RG1	10000	W/m²sr

risk group classification	RG 0	RG 1	RG 2	RG 3
		x		

Local BLH radiance distribution (left) and relevant region of the test object (right)



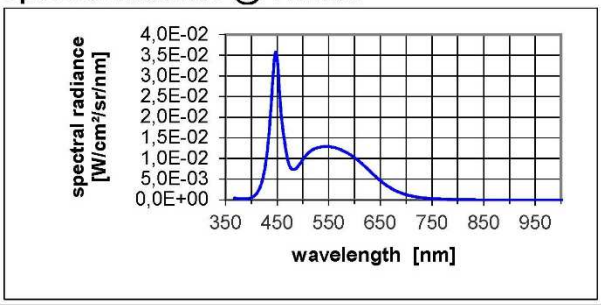


The corresponding blue light/retinal thermal effective radiance values and exposure limits are given below.
maximum permissible BLH dose (EN 62471): 1 MJ/(m²sr)

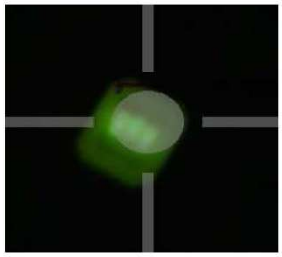
region no. and field of view α	distance d	condition	diameter D	luminance L_V	**blue light radiance L_B**	**exp. limit t_{max}**
[1]: 1,7 mrad	@ 200 mm		0,34 mm	14,3 Mcd/m²	**41,9 kW/(m²sr)**	**24 s**
[2]: 11 mrad	@ 200 mm		2,2 mm	7,36 Mcd/m²	**8,34 kW/(m²sr)**	**120 s**
[3]: 100 mrad	@ 200 mm		20 mm	0,14 Mcd/m²	**0,13 kW/(m²sr)**	**2,1 h**

RTH: The maximum exposure time in 1,7 mrad (region [1]) is longer than 10 s. The retinal thermal hazard is negligible.

Spectral radiance @ 11mrad



position of the spectral measurement:
(see crosshairs)



Duris E2835 GW JTLRS1 EM no. e767 150mA 200mm a.xlsx

Deutsche Akkreditierungsstelle D-PL-17666-02-00

Test Report issued under the responsibility of:

OSRAM

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

Report Number. ..... :	**216-16b**
Date of issue ..... :	**10. October 2016**
Total number of pages ..... :	**11**
Name of Testing Laboratory preparing the Report ..... :	**Central Laboratory for Light Measurements** OSRAM GmbH, CI ANM CLM Berliner Allee 65; 86153 Augsburg, Germany
Applicant's name ..... :	Yeap, Sang Yee Jacqueline OS SSL AE (SSL Application Engineering)
Address ..... :	OSRAM Opto Semiconductors (M) Sdn. Bhd. Bayan Lepas Free Industr. Zone Phase 1 - Pen 3 11900 Penang Malaysia
Test specification:	
Standard ..... :	IEC TR 62778:2014 (Second Edition)
Test procedure ..... :	
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

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.
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 ..... :	Duris E2835
Trade Mark ..... :	OSRAM
Manufacturer ..... :	OSRAM Opto Semiconductors
Model/Type reference ..... :	GW JTLRS1.EM
Ratings ..... :	150 mA DC (max. current) – 6500K (highest available CCT)

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):

☒	**Testing Laboratory:**	**Central Laboratory for Light Measurements**
Testing location/ address ..... :		OSRAM GmbH, CI ANM CLM Berliner Allee 65; 86153 Augsburg, Germany ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-17666-02-00
Tested by (name, function, signature) :		A. Gurel, Test Engineer:
Approved by (name, function, signature) :		Dr. Walter Steudtner, Head of laboratory:
☐	**Associated Testing Laboratory:**	
Testing location/ address ..... :		
Tested by (name, function, signature) ..... :		
Approved by (name, function, signature) ... :		
☐	**Testing procedure: Elsewhere:**	
Testing location/ address ..... :		
Tested by (name, function, signature) ..... :		
Approved by (name, function, signature) ... :		

List of Attachments (including a total number of pages in each attachment):

Attachment 1: Measurement results for Duris E2835 GW JTLRS1.EM / Page 10

Summary of testing:

Duris E2835 GW JTLRS1.EM:

- **RG1 (11mrad@200mm) low risk**
  Blue light hazard L_B = 8,34 kW•m^{-2}•sr^{-1} (11mrad@200mm)

Tests performed (name of test and test clause):	**Testing location:**
Test was performed according to clause 5 MEASUREMENT OF LAMPS AND LAMP SYSTEMS of IEC 62471:2006 (ed.1) 5.2.2 Radiance measurements 5.2.2.1 Standard method and according to clause 7 Application OF IEC 62471 FOR THE ASSESSMENT OF BLUE LIGHT HAZARD TO LIGHT SOURCES AND LUMINAIRES of IEC TR 62778:2014 (ed. 2) 7.2 Conditions for the radiance measurement.	Central Laboratory for Light Measurements OSRAM GmbH, CI ANM CLM Berliner Allee 65; 86153 Augsburg, Germany

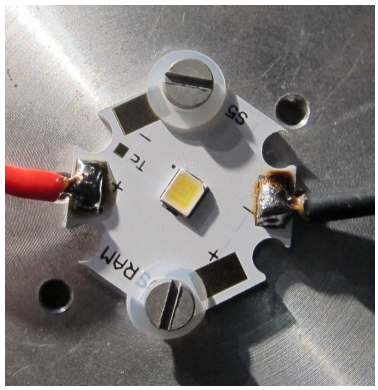
Summary of compliance with National Differences (List of countries addressed):

Tested products comply to the IEC TR 62778 Application of IEC 62471 for the assessment of blue light hazard to light sources and luminaires

☐ **The product fulfils the requirements of _____ (insert standard number and edition and delete the text in parenthesis, leave it blank or delete the whole sentence, if not applicable)**

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 Certification Bodies that own these marks.



Object no. e767 mounted on an OSRAM Duris S5 PCB.

Test item particulars .....:	Duris E2835 GW JTLRS1.EM no. e767
Product evaluated .....:	☐ **LED package** ☒ **LED module** ☒ **Lamp** ☒ **Luminaire**
Rated voltage (V) .....:	9,92V
Rated current (mA).....:	150 mA DC (max. current)
Rated CCT (K) .....:	6500K (highest available CCT)
Rated Luminance (Mcd/m^2).....:	NA
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 ..... :	05.10.2016
Date (s) of performance of tests..... :	06.10.2016

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.

Name and address of factory (ies)..... :

General product information:

IEC TR 62778			
Clause	Requirement + Test	Result - Remark	Verdict

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

	TABLE: Spectroradiometric measurement		
	Measurement performed on:	☐ **LED package** ☒ **LED module** ☐ **Lamp** ☐ **Luminaire**	
	Model number.....:	Duris E2835 GW JTLRS1.EM	
	Test voltage (V) .....:	9,92V	—
	Test current (mA) .....:	150 mA (max. current)	—
	Test frequency (Hz).....:	-	—
	Ambient, t (°C) .....:	25°C	—
	Measurement distance.....:	☒ 20 cm ☐ ... cm	—
	Source size .....:	☒ Non-small ☐ Small : .... mm	—
	Field of view .....:	☐ 100 mrad ☒ 11 mrad ☐ 1,7 mrad (for small sources)	—

Item	Symbol	Units	Result	Remark
Correlated colour temperature	CCT	K	7319	complete LED
x/y colour coordinates	x/y		0,301/0,317	complete LED
Blue light hazard radiance	L_B	kW/(m^2•sr^1)	8,34	11mrad
Blue light hazard irradiance	E_B	W/m^2	1,16	200mm
Luminance	L	Mcd/m^2	7,36	11mrad
Illuminance	E	lx	1190	200mm

Supplementary information:

	TABLE: Angular light distribution	NA

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
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**) instruments calibrated by standard lamps (see above)*

All standard lamps are traceable to the German NMI: Physikalisch Technische Bundesanstalt

Central Laboratory for Light Measurements

enclosure 1 to report **216-16b**

Blue Light / Retinal Thermal Hazard classification of **Duris E2835 GW JTLRS1 EM no. e767**

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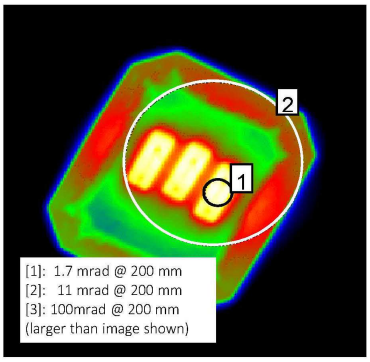
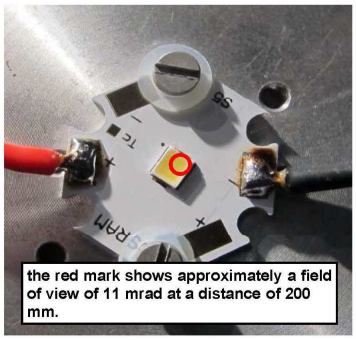
measured system voltage		9,92 V DC
measured current		0,15 A
measured system power		1,49 W
temperature 25°C		thermally stabilized
burning position		as depicted
CCT	(11 mrad @ 200mm)	9897 K
BLH	(11 mrad @ 200 mm)	**8,34 kW/(m²sr)**
BLH	(100 mrad @ 200mm)	**0,13 kW/(m²sr)**
emission limits according to EN 62471		
BLH emission limit RG1	10000	W/m²sr

risk group classification	RG 0	RG 1	RG 2	RG 3
		x		

Local BLH radiance distribution (left) and relevant region of the test object (right)





The corresponding blue light/retinal thermal effective radiance values and exposure limits are given below.
maximum permissible BLH dose (EN 62471): 1 MJ/(m²sr)

region no. and field of view α	distance d	condition	diameter D	luminance L_V	**blue light radiance L_B**	**exp. limit t_{max}**
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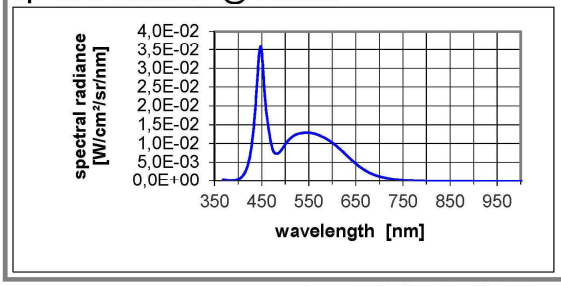
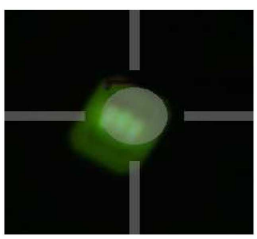
RTH: The maximum exposure time in 1,7 mrad (region [1]) is longer than 10 s. The retinal thermal hazard is negligible.

Spectral radiance @ 11mrad



position of the spectral measurement:
(see crosshairs)



Duris E2835 GW JTLRS1 EM no. e767 150mA 200mm b.xlsx

LED Family:
DURIS E 2835
Corresponding photo biological safety report:
216-16b

LED	Test Status	Tested current	IEC 62471	IEC TR 62778
GW JTLRS1.EM	Tested Device	0.15A	RG1	RG1 unlimited
GW JTLRS1.CM	Covered Device	N/A	RG1	RG1 unlimited
GW JTLPS1.CM	Covered Device	N/A	RG1	RG1 unlimited
GW JTLPS1.EM	Covered Device	N/A	RG1	RG1 unlimited
GW JTLPS2.CM	Covered Device	N/A	RG1	RG1 unlimited
GW JTLPS2.EM	Covered Device	N/A	RG1	RG1 unlimited
GW JTLRSX.EM	Covered Device	N/A	RG1	RG1 unlimited
GW JTLRSX.CM	Covered Device	N/A	RG1	RG1 unlimited
GW JTLQS1.EM	Covered Device	N/A	RG1	RG1 unlimited

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

END OF DOCUMENT