






<b>TEST REPORT</b> <b>IEC 62471</b> <b>Photobiological safety of lamps and lamp systems</b>	
<b>Report Reference No.</b> .....	<b>402586TRFPHO</b>
<b>Date of issue</b> .....	<b>2020-07-31</b>
<b>Total number of pages</b> .....	<b>24 (including attachments)</b>
<b>Name of Testing Laboratory preparing the Report</b> .....	<b>Nemko Spa</b> Via del Carroccio, 4 - 20853 Biassono (MB) – ITALY
<b>Applicant's name</b> .....	<b>C Luce Srl</b>
<b>Address</b> .....	<b>Via Marmolada 5/11 – 20060 Trucazzano (MI) – ITALY</b>
<b>Test specification:</b>	
<b>Standard</b> .....	<b>IEC 62471:2006</b>
<b>Test procedure</b> .....	<b>Testing</b>
<b>Non-standard test method</b> .....	<b>N/A</b>
<b>Test Report Form No.</b> .....	<b>IEC62471B</b>
<b>TRF Originator</b> .....	<b>VDE Testing and Certification Institute</b>
<b>Master TRF</b> .....	<b>Dated 2018-08-16</b>
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<b>Test item description .....</b>	<b>LED floodlight</b>	
<b>Trade Mark.....</b>		
<b>Manufacturer .....</b>	C Luce ( )	
<b>Manufacturer .....</b>	C Luce Srl	
<b>Model/Type reference.....</b>	MATCH 251643.384	
<b>Ratings.....</b>	960 W 220-240 V ~ 50-60 Hz 850 mA, 4000 K	
<b>Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):</b>		
<input checked="" type="checkbox"/>	<b>Testing Laboratory:</b>	
<b>Testing location/ address .....</b>		Nemko Spa, Via del Carroccio, 4 – Biassono (MB) – ITALY
<b>Tested by (name, function, signature) .....</b>		Segantin Oscar (Project Handler) 
<b>Approved by (name, function, signature) ..</b>		Kelly Ye (Verifier) 
<input type="checkbox"/>	<b>Testing procedure: CTF Stage 1:</b>	
<b>Testing location/ address .....</b>		
<b>Tested by (name, function, signature) .....</b>		
<b>Approved by (name, function, signature) ..</b>		
<input type="checkbox"/>	<b>Testing procedure: CTF Stage 2:</b>	
<b>Testing location/ address .....</b>		
<b>Tested by (name + signature).....</b>		
<b>Witnessed by (name, function, signature) . :</b>		
<b>Approved by (name, function, signature) .. :</b>		
<input type="checkbox"/>	<b>Testing procedure: CTF Stage 3:</b>	
<input type="checkbox"/>	<b>Testing procedure: CTF Stage 4:</b>	
<b>Testing location/ address .....</b>		
<b>Tested by (name, function, signature) .....</b>		
<b>Witnessed by (name, function, signature) . :</b>		
<b>Approved by (name, function, signature) .. :</b>		
<b>Supervised by (name, function, signature) :</b>		

<p><b>List of Attachments (including a total number of pages in each attachment):</b></p> <ul style="list-style-type: none"> <li>- Attachment 1: Best Measurement Capability (1 page)</li> <li>- Attachment 2: European group differences and national differences (2 pages)</li> <li>- Attachment 3: Labelling requirements of IEC/TR 62471-2 (2 pages)</li> <li>- Attachment 4: Characteristics of lamps (1 page)</li> <li>- Attachment 5: Photo documentation (2 pages)</li> <li>- Attachment 6: Equipment used for testing (1 page)</li> </ul>	
<p><b>Summary of testing:</b></p> <ul style="list-style-type: none"> <li>- The equipment under test is a streetlight LED. According to the standard, it has been considered as a general lighting service (GLS).</li> <li>- The radiation measurements were carried out at the distance of 500 lx as requested by the standard.</li> </ul>	
<p><b>Tests performed (name of test and test clause):</b></p> <p>Cl. 4- Exposure Limits Cl. 5- Measurement of lamp and lamp system Cl. 6- Lamp classification</p> <p><b>Note:</b> The following Nemko technical procedures were also applied during testing:</p> <ul style="list-style-type: none"> <li>- WML0177 General routines for using instruments at Nemko.</li> <li>- WML1002: Measurement Uncertainty – Policy and Statement.</li> <li>- WML0066: Procedure for measurement of Photobiological safety of lamps and lamp systems</li> </ul> <p><b>Statement of the measurement uncertainty:</b> See Attachment 1 for Measurement uncertainty</p> <p><b>Unless different values are declared in the test case, following ambient conditions apply for the tests:</b></p> <ul style="list-style-type: none"> <li>- Ambient temperature 18-33 °C</li> <li>- Relative Humidity 30-70 %</li> <li>- Atmospheric Pressure 860-1060 hPa</li> </ul> <p>Equipment used for testing is recorded and saved into Attachment 6 to this test report.</p>	<p><b>Testing location:</b></p> <p>Nemko Spa Via del Carroccio, 4 – 20853 Biassono (MB) – ITALY (for all tests)</p>
<p><b>Summary of compliance with National Differences (List of countries addressed):</b></p> <ul style="list-style-type: none"> <li>- All CENELEC member countries</li> </ul> <p><input checked="" type="checkbox"/> <b>The product fulfils the requirements of:</b></p> <ul style="list-style-type: none"> <li>- EN 62471:2008</li> </ul>	

**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.

**NOT PROVIDED**

<p><b>Calibration</b></p>	<p>All instruments used in the tests given in this test report are calibrated and traceable to national or international standards. Further information about traceability will be given on request.</p>
<p><b>Measurement uncertainty</b></p>	<p>The measurement uncertainty was calculated for each test and quantity listed in this test report, according to IEC Guide 115 and other specific test standard and is documented in Nemko Spa working manual WML1002.</p>
<p><b>Assessment of conformity</b></p>	<p>The assessment of conformity for each test performed on the equipment is performed not taking into account the measurement uncertainty. The two following possible verdicts are stated in the report: P (Pass) - The measured values of the equipment respect the specification limit at the points tested. The specific risk of false accept is up to 50% when the measured result is close to the limit. F (Fail) - One or more measured values of the equipment do not respect the specification limit at the points tested. The specific risk of false reject is up to 50% when the measured result is close to the limit.</p>

<b>Test item particulars</b> .....	<b>LED floodlight</b>
Tested lamp .....	<input checked="" type="checkbox"/> continuous wave lamps <input type="checkbox"/> pulsed lamps
Tested lamp system .....	:
Lamp classification group.....	<input checked="" type="checkbox"/> exempt <input type="checkbox"/> risk 1 <input type="checkbox"/> risk 2 <input type="checkbox"/> risk 3
Lamp cap .....	: --
Bulb .....	: --
Rated of the lamp .....	: Refer to first page of this test report
Furthermore marking on the lamp .....	: --
Seasoning of lamps according IEC standard .....	: --
Used measurement instrument.....	: Monochromator with its optical accessories. See also Attachment 5.
Temperature by measurement .....	: 26 °C
Information for safety use.....	: None
<b>Possible test case verdicts:</b>	
– <b>test case does not apply to the test object</b> ..... : N/A (not applicable)	
– <b>test object does meet the requirement</b> ..... : P (Pass)	
– <b>test object does not meet the requirement</b> ..... : F (Fail)	
<b>Testing:</b>	
<b>Date of receipt of test item</b> .....	: 2020-07-20
<b>Date (s) of performance of tests</b> .....	: 2020-07-29
<b>General remarks:</b>	
<p>"The phase of sampling / collection of equipment under test is carried out by the customer."          "(See Enclosure #)" refers to additional information appended to the report.          "(See appended table)" refers to a table appended to the report.          The phase of sampling/collection is carried out by manufacturer.  <b>Throughout this report a <input checked="" type="checkbox"/> comma / <input type="checkbox"/> point is used as the decimal separator.</b></p>	
<b>General product information and other remarks:</b>	
<p>The equipment under test is a LED floodlight for general purpose, composed by:</p> <ul style="list-style-type: none"> <li>- 8 LED modules (each module consists of 48 LED packages and a plastic lens array providing symmetric light beam of 15°, see attachment 4 for further characteristics of the LED packages);</li> <li>- 4 controlgears model XLG-240-L-A manufactured by MEAN WELL with ratings:              Input: 2,7 A 100-240 V 50/60 Hz              Output: 239,4 W 370 Vmax</li> </ul> <p>Light emitting area: 1050x410 mm</p> <p>s/n: 402586 1/1 identified by Nemko Spa</p>	

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Clause	Requirement + Test	Result – Remark	Verdict
<b>4</b>	<b>EXPOSURE LIMITS</b>		
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 $10^4 \text{ cd}\cdot\text{m}^{-2}$	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 $30 \text{ J}\cdot\text{m}^{-2}$ within any 8-hour period		P
	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:		P
	$E_s \cdot t = \sum_{200}^{400} \sum_t E_\lambda(\lambda, t) \cdot S_{UV}(\lambda) \cdot \Delta t \cdot \Delta \lambda \leq 30 \quad \text{J}\cdot\text{m}^{-2}$		P
	The permissible time for exposure to ultraviolet radiation incident upon the unprotected eye or skin shall be computed by:		P
	$t_{\max} = \frac{30}{E_s} \quad \text{s}$		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 $10000 \text{ J}\cdot\text{m}^{-2}$ 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 $10 \text{ W}\cdot\text{m}^{-2}$ .		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
	$t_{\max} \leq \frac{10\,000}{E_{UVA}} \quad \text{s}$		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

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	$L_B \cdot t = \sum_{300}^{700} \sum_t L_\lambda(\lambda, t) \cdot B(\lambda) \cdot \Delta\lambda \leq 10^6 \quad \text{J} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$	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 $E_\lambda$ , 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, $L_\lambda$ , 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

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4.3.8	Thermal hazard exposure limit for the skin		P
	Visible and infrared radiant exposure (380 nm to 3000 nm) of the skin shall be limited to:	Refer below:	P
	$E_H \cdot t = \sum_{380}^{3000} \sum_t E_\lambda(\lambda, t) \cdot \Delta t \cdot \Delta \lambda \leq 20\,000 \cdot t^{0,25} \quad \text{J} \cdot \text{m}^{-2}$	Limit value: 3560 W/m <sup>2</sup> Measured: 1,3 W/m <sup>2</sup>	P
<b>5</b>	<b>MEASUREMENT OF LAMPS AND LAMP SYSTEMS</b>		
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)		P
	Seasoning of lamps shall be done as stated in the appropriate IEC lamp standard.		P
5.1.2	Test environment	Refer below:	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.	Considered.	P
5.1.3	Extraneous radiation	Refer below:	P
	Careful checks should be made to ensure that extraneous sources of radiation and reflections do not add significantly to the measurement results.	Dark room	P
5.1.4	Lamp operation	Refer below:	P
	Operation of the test lamp shall be provided in accordance with:	Refer below:	P
	– the appropriate IEC lamp standard, or		N/A
	– the manufacturer's recommendation		P
5.1.5	Lamp system operation	Refer below:	P
	The power source for operation of the test lamp shall be provided in accordance with:	Refer below:	P
	– the appropriate IEC standard, or		N/A
	– the manufacturer's recommendation		P
5.2	Measurement procedure		P
5.2.1	Irradiance measurements	Refer below:	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



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5.2.2	Radiance measurements	Refer below:	P
5.2.2.1	Standard method	Refer below:	P
	The measurements made with an optical system.		P
	The instrument shall be calibrated to read in absolute radiant power per unit receiving area and per unit solid angle to acceptance averaged over the field of view of the instrument.		P
5.2.2.2	Alternative method	Refer below:	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	Refer below:	P
	The determination of $\alpha$ , the angle subtended by a source, requires the determination of the 50% emission points of the source.	Considered source size 410x1050 mm. $\alpha = 15,5$ mrad	P
5.2.4	Pulse width measurement for pulsed sources		N/A
	The determination of $\Delta t$ , 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	Refer below:	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	Refer below:	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	Refer below:	P
	The quality of all measurement results must be quantified by an analysis of the uncertainty.	see Annex C in the norm	P
<b>6</b>	<b>LAMP CLASSIFICATION</b>		
	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	500 lx measured at 47 m	P

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	– for all other light sources, including pulsed lamp sources, the hazard values shall be reported at a distance of 200 mm		N/A
6.1	Continuous wave lamps		N/A
6.1.1	Except Group		P
	In the except group are lamps, which does not pose any photobiological hazard. The requirement is met by any lamp that does not pose:		P
	– an actinic ultraviolet hazard ( $E_s$ ) within 8-hours exposure (30000 s), nor		P
	– a near-UV hazard ( $E_{UVA}$ ) within 1000 s, (about 16 min), nor		P
	– a retinal blue-light hazard ( $L_B$ ) within 10000 s (about 2,8 h), nor		P
	– a retinal thermal hazard ( $L_R$ ) within 10 s, nor		P
	– an infrared radiation hazard for the eye ( $E_{IR}$ ) within 1000 s		P
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)		N/A
	This requirement is met by any lamp that exceeds the limits for Risk Group 1, but that does not pose:		N/A
	– 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
	– 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

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	Lamps that emit infrared radiation without a strong visual stimulus and do not pose a near-infrared retinal hazard (L <sub>R</sub> ), within 10 s are in Risk Group 2.		N/A
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
	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

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Clause	Requirement + Test	Result – Remark	Verdict

Table 4.1		Spectral weighting function for assessing ultraviolet hazards for skin and eye		P
Wavelength <sup>1</sup> $\lambda$ , nm	UV hazard function $S_{uv}(\lambda)$	Wavelength $\lambda$ , 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	

<sup>1</sup> Wavelengths chosen are representative: other values should be obtained by logarithmic interpolation at intermediate wavelengths.  
\* Emission lines of a mercury discharge spectrum.

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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

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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 <sup>0,75</sup> 100
Skin thermal	$E_H = \sum E_\lambda \cdot \Delta\lambda$	380 – 3000	< 10	2π sr	20000/t <sup>0,75</sup>

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·√(t/10) 0,011 0,0011·√t 0,1	10 <sup>6</sup> /t 10 <sup>6</sup> /t 10 <sup>6</sup> /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·√(t/10)	50000/(α·t <sup>0,25</sup> ) 50000/(α·t <sup>0,25</sup> )
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									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	<b>0,00000</b>	0,003	-	0,03	-
Near UV		$E_{UVA}$	$W \cdot m^{-2}$	10	<b>0,0</b>	33	-	100	-
Blue light	$B(\lambda)$	$L_B$	$W \cdot m^{-2} \cdot sr^{-1}$	100	<b>28,3</b>	10000	-	4000000	-
Blue light, small source	$B(\lambda)$	$E_B$	$W \cdot m^{-2}$	1,0*	-	1,0	-	400	-
Retinal thermal	$R(\lambda)$	$L_R$	$W \cdot m^{-2} \cdot sr^{-1}$	$28000/\alpha = 1,81E06$	<b>629</b>	$28000/\alpha$	-	$71000/\alpha$	-
Retinal thermal, weak visual stimulus**	$R(\lambda)$	$L_{IR}$	$W \cdot m^{-2} \cdot sr^{-1}$	$6000/\alpha$	-	$6000/\alpha$	-	$6000/\alpha$	-
IR radiation, eye		$E_{IR}$	$W \cdot m^{-2}$	100	<b>0,0</b>	570	-	3200	-

\* 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

### ATTACHMENT 1: MEASUREMENT UNCERTAINTY

Test	Range	Measurement Uncertainty	Note
Radiance Blue light, Retinal thermal, Retinal thermal weak visual stimulus	0 ÷ 0.1 MW/(sr·m <sup>2</sup> ) 300 ÷ 1400 nm	7.0 %	(1)
	0.1 ÷ 100 MW/(sr·m <sup>2</sup> ) 300 ÷ 1400 nm	8.0 %	(4)
Luminance	0 ÷ 0.1 Mcd/m <sup>2</sup>	7.0 %	(1)
	0.1 ÷ 100 Mcd/m <sup>2</sup>	8.0 %	
Irradiance Actinic UV, Near UV, Blue light small source, IR radiation, eye	0 ÷ 0.1 MW/(m <sup>2</sup> ) 200 ÷ 300 nm	9.2 %	(1) (5)
	0.1 ÷ 100 MW/(m <sup>2</sup> ) 200 ÷ 300 nm	10.0 %	
	0 ÷ 0.1 MW/(m <sup>2</sup> ) 300 ÷ 3000 nm	6.4 %	
	0.1 ÷ 100 MW/(m <sup>2</sup> ) 300 ÷ 3000 nm	7.2 %	
Illuminance	0 ÷ 20 klx	4.0 %	(1)
Spectral Radiance	0 ÷ 0.1 MW/(sr·m <sup>2</sup> ·nm) 300 ÷ 1400 nm	6.2 %	(1)
	0.1 ÷ 1 MW/(sr·m <sup>2</sup> ·nm) 300 ÷ 1400 nm	7.0 %	
Spectral Irradiance	0 ÷ 0.1 MW/(m <sup>2</sup> ·nm) 200 ÷ 300 nm	8.6 %	(1)
	0.1 ÷ 1 MW/(m <sup>2</sup> ·nm) 200 ÷ 300 nm	9.2 %	
	0-0.1 MW/(m <sup>2</sup> ·nm) 300 ÷ 3000nm	5.4 %	
	0.1 ÷ 1 MW/(m <sup>2</sup> ·nm) 300 ÷ 3000 nm	6.4 %	
Radiant power Laser radiation Output power	350 ÷ 400 nm 950 ÷ 3000 nm 30 uW ÷ 30 W	9.0 %	(1), (2), (3)
	400 ÷ 950 nm 50 nW ÷ 3 W	4.6 %	(1), (2), (3)
Radiant energy Laser radiation	350 ÷ 400 nm 950 ÷ 3000 nm 20 uJ ÷ 2 J	9.0 %	(1), (2)
	400 ÷ 950 nm 20 uJ ÷ 2 J	4.6 %	(1), (2)
Wavelength	200 ÷ 3000 nm	4.5 %	(1)
Length in optical measurement	0 ÷ 20 mm	0.5 mm	(1)
	20 ÷ 200 mm	2 mm	
	0.2 ÷ 200 m	0.5 %	

**NOTES:**

- (1) The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k = 2$ , which for a normal distribution corresponds to a coverage probability of approximately 95 %
- (2) In the standard 60825-1 laser radiation can indicate radiant power or radiant energy
- (3) In the standard 60825-1 the radiant power can be called also output power
- (4) The uncertainty value expressed in  $W/(m^2)$  is the maximum value between the value measured and the limit stated in the standard (see IEC/EN62471) multiplied to the measurement uncertainty stated in the table
- (5) The uncertainty value expressed in  $W/(sr \cdot m^2)$  is the maximum value between the value measured and the limit stated in the standard (see IEC/EN62471) multiplied to the measurement uncertainty stated in the table



IEC62471B - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict

<b>ATTACHMENT 2 TO TEST REPORT IEC 62471</b> <b>EUROPEAN GROUP DIFFERENCES AND NATIONAL DIFFERENCES</b> Photobiological safety of lamps and lamps systems			
<b>Differences according to</b> .....: EN 62471:2008			
<b>Attachment Form No.</b> .....: EU_GD_IEC62471B_Nemko			
<b>Attachment Originator</b> .....: Nemko Spa			
<b>Master Attachment</b> .....: 2019-09			
This attachment has been developed by Nemko Spa, starting from Attachment Form No. EU_GD_IEC62471B.			

<b>CENELEC COMMON MODIFICATIONS (EN)</b>			P
<b>4</b>	<b>EXPOSURE LIMITS</b>		P
	Contents of the whole Clause 4 of IEC 62471:2006 moved into a new informative Annex ZB		—
	Clause 4 replaced by the following:		P
	Limits of the Artificial Optical Radiation Directive (2006/25/EC) have been applied instead of those fixed in IEC 62471:2006	See appended Table 6.1	P
4.1	General		P
	First paragraph deleted		—

Table 6.1 Emission limits and evaluation based on EU Directive 2006/25/EC					P
Risk	Action spectrum	Symbol	Units	Limit <sup>(1)</sup>	Result <sup>(2)</sup>
Actinic UV	SUV( $\lambda$ )	$E_s$	$W \cdot m^{-2}$	0,00104 <sup>(5)</sup>	<b>0,00000</b>
Near UV		$E_{UVA}$	$W \cdot m^{-2}$	0,347 <sup>(5)</sup>	<b>0,0000</b>
Blue light	B( $\lambda$ )	$L_B$	$W \cdot m^{-2} \cdot sr^{-1}$ s	$L_B = 100$ $t > 10000$ s	<b>L = 28,3</b>
				$L_B = 10^6/t$ $t \leq 10000$ s	—
Blue light, small source <sup>(3)</sup>	B( $\lambda$ )	$E_B$	$W \cdot m^{-2}$ s	$E_B = 0,01$ $t > 10000$ s	—
				$E_B = 100/t$ $t \leq 10000$ s	—
Retinal thermal	R( $\lambda$ )	$L_R$	$W \cdot m^{-2} \cdot sr^{-1}$ s	$L_R = 2,8 \cdot 10^4/\alpha$ $t > 10$ s	<b>L = 629</b>
				$L_R = 5 \cdot 10^4/(\alpha \cdot t^{0,25})$ $10 \mu s \leq t \leq 10$ s	—
				$L_R = 8,89 \cdot 10^5/\alpha$ , $t < 10 \mu s$	—
Retinal thermal, weak visual stimulus <sup>(4)</sup>	R( $\lambda$ )	$L_{IR}$	$W \cdot m^{-2} \cdot sr^{-1}$ s	$L_{IR} = 6000/\alpha$ $t > 10$ s	—
				$L_{IR} = 5 \cdot 10^4/(\alpha \cdot t^{0,25})$ $10 \mu s \leq t \leq 10$ s	—
				$L_{IR} = 8,89 \cdot 10^5/\alpha$ $t < 10 \mu s$	—
IR radiation, eye		$E_{IR}$	$W \cdot m^{-2}$ s	$E_{IR} = 100$ $t > 1000$ s	<b>0,0</b>
				$E_{IR} = 18000 \cdot t^{-0,75}$ $t \leq 1000$ s	—

(1)  $\alpha$  is expressed in radians.  
 (2)  $t$  is the exposure time of the lamp and is expressed in seconds; if  $t \geq 0$  there is no limitation is the exposure.  
 (3) Small source defined as one with  $\alpha < 0,011$  radian. Averaging field of view at 10000 s is 0,1 radian.  
 (4) Involves evaluation of non-GLS source.  
 (5) The limits  $H_{eff} = 30$  and  $H_{UVA} = 10^4 J \cdot m^{-2}$  are converted in  $W \cdot m^{-2}$  considering the exposure time of 8 hours.

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.

<b>ATTACHMENT 3 TO TEST REPORT IEC/EN 62471</b> <b>REQUIREMENT OF IEC/TR 62471-2</b> Photobiological safety of lamps and lamps systems – Part 2: Guidance on manufacturing requirement relating to non-laser optical radiation safety	
<b>Originator</b> .....	Nemko S.p.A.
<b>Date of issue</b> .....	2013 – 04

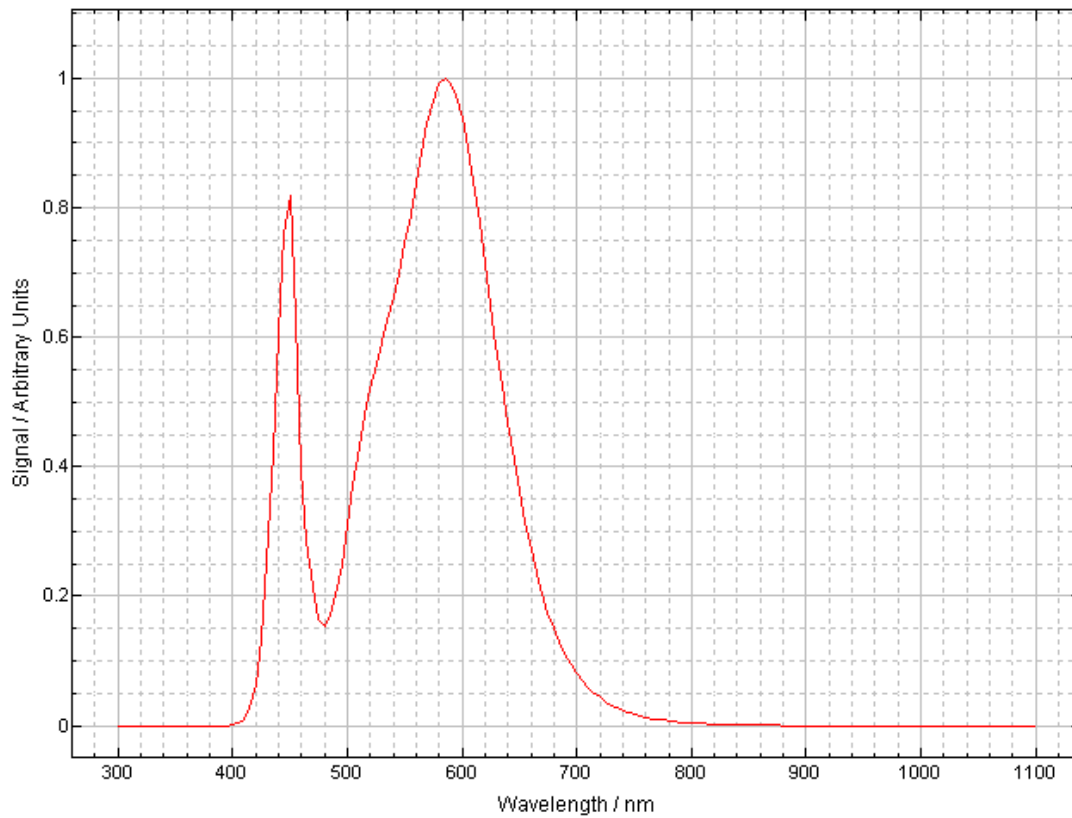
5.4	<b>Labelling required</b>	-			
<table border="1" style="margin: auto;"> <tr><td style="text-align: center;"><b>Exempt</b></td></tr> <tr><td style="text-align: center;"><b>No Labelling Required</b></td></tr> <tr><td style="text-align: center;"><i>Product tested against IEC62471</i></td></tr> </table>			<b>Exempt</b>	<b>No Labelling Required</b>	<i>Product tested against IEC62471</i>
<b>Exempt</b>					
<b>No Labelling Required</b>					
<i>Product tested against IEC62471</i>					

<b>Table 1</b>	Hazard-related risk group labelling of lamp systems				-
Hazard	Exempt Risk Group	Risk Group 1	Risk Group 2	Risk Group 3	
Ultraviolet hazard 200nm to 400nm	<b>Not required</b>	NOTICE UV emitted from this product	CAUTION UV emitted from this product	WARNING UV emitted from this product	
Retinal blue light hazard 300nm to 400nm	<b>Not required</b>	Not required	CAUTION Possibly hazard- ous optical radi- ation emitted from this product	WARNING Possibly hazardous optical radiation emitted from this product	
Retinal blue light or thermal hazard 400nm to 780nm	<b>Not required</b>	Not required	CAUTION Possibly hazard- ous optical radi- ation emitted from this product	WARNING Possibly hazardous optical radiation emitted from this product	
Cornea/lens infrared hazard 780nm to 3000nm	<b>Not required</b>	NOTICE IR emitted from this product	CAUTION IR emitted from this product	WARNING IR emitted from this product	
Retinal thermal hazard weak visual stimulus 780nm to 1400nm	<b>Not required</b>	WARNING IR emitted from this product	WARNING IR emitted from this product	WARNING IR emitted from this product	
<b>Supplementary information:</b> in bold explanation of labelling information and guidance on control measures					

<b>Table 2</b>		Explanation of labelling information and guidance on control measure			-
<b>Hazard</b>	<b>Exempt Risk Group</b>	<b>Risk Group 1</b>	<b>Risk Group 2</b>	<b>Risk Group 3</b>	
Ultraviolet hazard 200nm to 400nm	<b>Not required</b>	Minimise exposure to eyes or skin. Use appropriate shielding.	Eye or skin irritation may result from exposure. Use appropriate shielding.	Avoid eye and skin exposure to unshielded product.	
Retinal blue light hazard 300nm to 400nm	<b>Not required</b>	Not required	Do not stare at operating lamp. May be harmful to the eyes.	Do not look at operating lamp. Eye injury may result.	
Retinal blue light or thermal hazard 400nm to 780nm	<b>Not required</b>	Not required	Do not stare at operating lamp. May be harmful to the eyes.	Do not look at operating lamp. Eye injury may result.	
Cornea/lens infrared hazard 780nm to 3000nm	<b>Not required</b>	Use appropriate shielding or eye protection.	Avoid eye exposure. Use appropriate shielding or eye protection.	Avoid eye exposure. Use appropriate shielding or eye protection.	
Retinal thermal hazard weak visual stimulus 780nm to 1400nm	<b>Not required</b>	Do not stare at operating lamp.	Do not stare at operating lamp.	Do not look at operating lamp.	
<b>Supplementary information:</b> in bold explanation of labelling information and guidance on control measures					

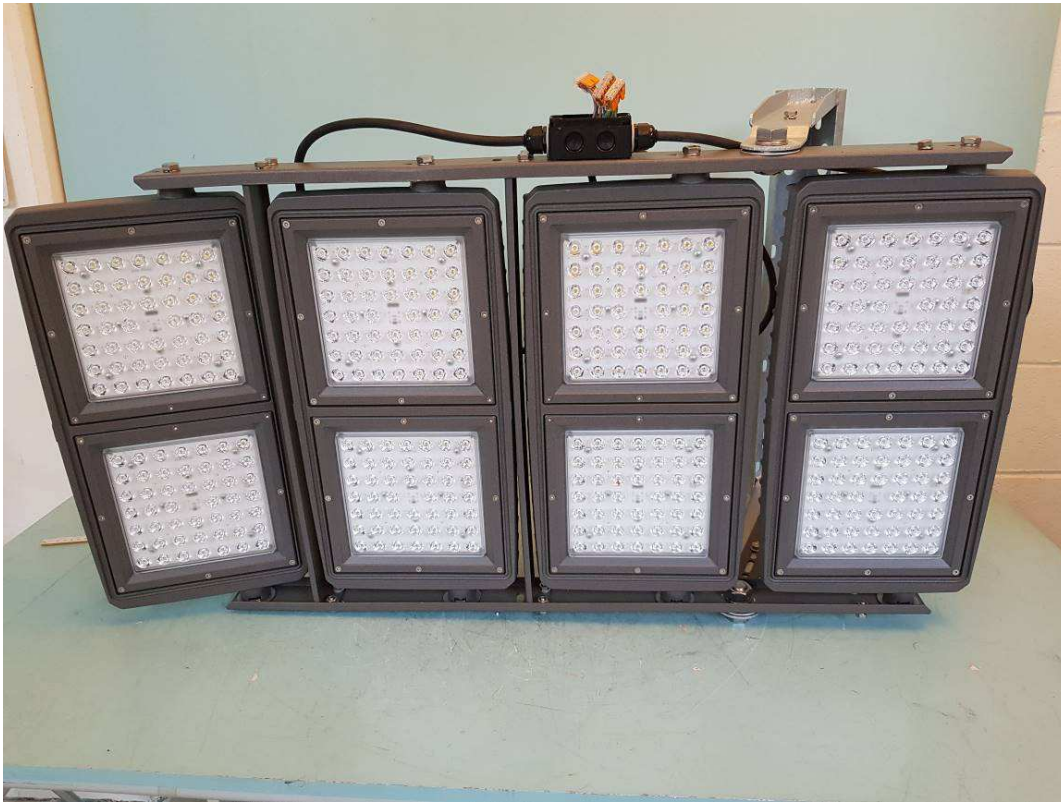
### ATTACHMENT 4: CHARACTERISTICS OF LAMP

Application / Function	Manufacturer trademark	Type / Model	Technical data	Standard	Mark(s) of conformity evidence of acceptance
LEDs	SAMSUNG	LH351C	4000 K 70 CRI V <sub>F</sub> 3,18 V <sub>max</sub> at I <sub>F</sub> 2000 mA 685 lm	IEC/EN 62471	Tested in appliance



Spectral measurement normalized

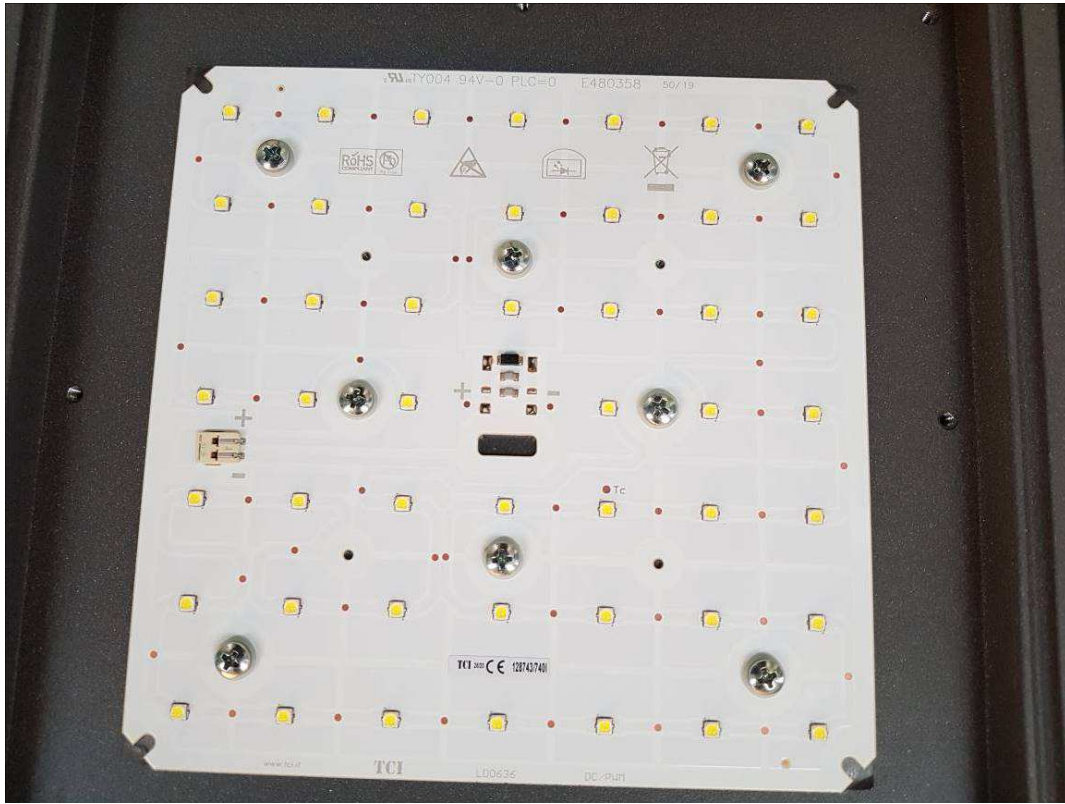
ATTACHMENT 5: PHOTO DOCUMENTATION



a)



b)



c)





From a) to d) General view of the equipment



**ATTACHMENT 6: EQUIPMENT USED FOR TESTING**

<b>MEASUREMENT EQUIPMENT</b>			
<b>Manufacturer</b>	<b>Type of equipment</b>	<b>Type designation</b>	<b>Serial number</b>
Bentham instruments	Double monochromator	IDR300	12290
	Calibration lamp for irradiance measurement	CL6-H	12094/5
	Calibration lamp for irradiance measurements (UV)	CL7	12281/3
	Calibration lamp for radiance measurements	SRS12	12283/3
	Telescope for radiance measurements	TEL309	12280/3
	Illuminance detector	DH400_vl	12284/3
	Power supply	PSU605	12236/4
	Power supply	PSU705	12295
	Diffuser	DIFF_D7	12279/3
	Source Profiler	PSL_Profiler	12698/4
Other instruments	Tape	Stanley 8 m	30-457
	Distance meter	Bosch DLE70	005558860
	Multimeter	Fluke 8846	9673012
	Power supply	Philips	003926
	Data logger	Testo 176P1+0572 6174	41002029+206 38516
	Data logger	Testo 184H1	44220017

-End of Report-