

**TEST REPORT**

**COMMISSION REGULATION 2019/2020 of 1 October 2019**

**Laying down ecodesign requirements for light sources and separate control gears pursuant to Directive 2009/125/EC of the European Parliament and of the council EN 13032-4 light and lighting –Measurement and presentation of photometric data of lamps and luminaires -Part 4:LED Light Sources, modules and luminaires And Commission Delegated Regulation (EU) 2019/2015 And Commission Delegated Regulation (EU) 2021/340 of 17 December 2020 And Commission Regulation (EU) 2021/341 of 23 February 2021**

<b>Report Number</b> .....	KEYS24041869001EP-01
<b>Date of issue</b> .....	April 25, 2024
<b>Total number of pages</b> .....	14 pages
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<b>Approved by (name + signature)</b> ...	Jason Zhan 
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<b>Applicant's name</b> .....	SHENZHEN LEDWORKER LIGHTING CO.,LTD
<b>Address</b> .....	5th Floor, Building A, Baitong Technology Innovation Industrial Park, 150 Shasong Road, Shenzhen,518104,China
<b>Manufacturer's name</b> .....	SHENZHEN LEDWORKER LIGHTING CO.,LTD
<b>Address</b> .....	5th Floor, Building A, Baitong Technology Innovation Industrial Park, 150 Shasong Road, Shenzhen,518104,China
<b>Test specification:</b>	
<b>Standard</b> .....	Commission Regulation (EU) 2019/2020, (EU) 2021/341 EN 13032-4:2015+A1:2019 Commission Delegated Regulation (EU) 2019/2015, (EU) 2021/340
<b>Test procedure</b> .....	Commission Regulation (EU) 2019/2020, (EU) 2021/341 EN 13032-4:2015+A1:2019 Commission Delegated Regulation (EU) 2019/2015, (EU) 2021/340
<b>Non-standard test method</b> .....	N/A
<b>General disclaimer:</b>	
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 KEYS Testing Laboratory.	
<b>Test item description</b> .....	2018 COB LED Strip
<b>Trade Mark</b> .....	N/A
<b>Model/Type reference</b> .....	COB028
<b>Ratings</b> .....	DC24V 15W

**Possible test case verdicts:**

- test case does not apply to the test object..... N or 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**..... November 24,2023

**Date (s) of performance of tests**..... November 24,2023 to April 25, 2024

**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.**
**General product parameters:**

Energy consumption in on-mode.....(kWh/1 000 h)	15
Rated useful luminous flux.....(lm)	2200
Rated CCT .....(K)	5800
On-mode power (Pon), expressed in.....(W)	15
Standby power (Psb).....(W)	N
Networked standby power(Pnet)for CLS..... (W)	N
Rated Ra.....	>90
Outer dimensions.....(mm)	N
Spectral power distribution.....	See Table 4: Spectral power distribution
Claim of equivalent power .....	<input type="checkbox"/> YES <input checked="" type="checkbox"/> No
Chromaticity coordinates (x and y).....	x: 0.44 y:0.41
Peak luminous intensity .....(cd)	N
Beam angle in degrees.....(°)	N
R9 colour rendering index value R9.....	60
Survival factor .....	≥90%
The lumen maintenance factor.....	≥93.12%
Displacement factor (cos φ1).....	N
Colour consistency in McAdam ellipses.....	≤6
Claims that an LED light source replaces a fluorescent light source without integrated ballast of a particular wattage.....	<input type="checkbox"/> YES <input checked="" type="checkbox"/> No
Flicker metric (Pst LM) .....	N
Stroboscopic effect metric (SVM).....	N
Rated life time .....(h)	15000

**Summary of testing:**

1. Measurement was conducted at voltage DC24V and the laboratory ambient for testing: 22.1-25.0°C, 50%-65%R.H.
2. All 'verdict' in this test report based on test at rated input; other conditions were not considered.
3. All tests were performed on light source intended operating orientation (horizontal, downward).

(EU) 2019/2020			
Clause	Requirement + Test	Result - Remark	Verdict

Annex I (Clause)	Definitions in Regulation (EU) 2019/2020		P
	Number of sample used for tested	10 pcs	P
(3)	Directional Light Source		N
	at least 80 % of total luminous flux within a solid angle of $\pi$ sr (corresponding to a cone with angle of $120^\circ$ )		N
(4)	Non-directional light source		P
(15)	Useful luminous flux $\Phi_{use}$		P
	for non-directional light sources it is the total flux emitted in a solid angle of $4\pi$ sr (corresponding to a $360^\circ$ sphere)		P
	for directional light sources with beam angle $\geq 90^\circ$ it is the flux emitted in a solid angle of $\pi$ sr (corresponding to a cone with angle of $120^\circ$ )		N
	for directional light sources with beam angle $< 90^\circ$ it is the flux emitted in a solid angle of $0,586\pi$ sr (corresponding to a cone with angle of $90^\circ$ )		N

Annex II (Clause)	Energy Efficiency Requirements in Regulation (EU) 2019/2020		P
1.1	Energy Efficiency Requirements – Light Source		P
	The declared power consumption of a light source $P_{on}$ shall not exceed the maximum allowed power $P_{onmax}$ (in W)		P
	On-mode Power $P_{on}$ (W):	See Appendix I table 1	P
	Maximum Allowed Power $P_{onmax}$ (W): $P_{onmax} = C \times (L + \Phi_{use}/(F \times \eta)) \times R$	See Appendix I table 1	P
1.1.1	Efficacy factor (F) is:		P
	Efficacy Factor F: 1.00 for non-directional light sources (NDLS, using total flux)	1.00	P
	Efficacy Factor F: 0.85 for directional light sources (DLS, using flux in a cone)		N
1.1.2	CRI factor (R) is:		P
	CRI Factor R: 0.65 for $CRI \leq 25$		N
	CRI Factor R: (CRI+80)/160 for $CRI > 25$ , rounded to two decimals		P
1.1.3	The values for threshold efficacy ( $\eta$ in lm/W) and end loss factor (L in W) are specified depending on the light source type		P
	Light source description		-
	LFL T5-HE	$\eta$ : 98.8 lm /W, L:1.9	N
	LFL T5-HO, $4\,000 \leq \Phi \leq 5\,000$ lm	$\eta$ :83.0 lm /W, L:1.9	N

## (EU) 2019/2020

Clause	Requirement + Test	Result - Remark	Verdict
	LFL T5-HO, other lm output	$\eta$ : 79.0 lm /W, L:1.9	N
	FL T5 circular	$\eta$ : 79.0 lm /W, L:1.9	N
	FL T8 (including FL T8 U-shaped)	$\eta$ : 98.8 lm /W, L:1.9	N
	From 1 September 2023, for FL T8 of 2-, 4- and 5-foot	$\eta$ : 120.0 lm /W, L:1.5	N
	Magnetic induction light source, any length/flux	$\eta$ : 70.2 lm /W, L:2.3	N
	CFLni	$\eta$ : 70.2 lm /W, L:2.3	N
	FL T9 circular	$\eta$ : 71.5 lm /W, L:6.2	N
	HPS single-ended	$\eta$ : 88.0 lm /W, L:50.0	N
	HPS double-ended	$\eta$ : 78.0 lm /W, L:47.7	N
	MH $\leq$ 405 W single-ended	$\eta$ : 84.5 lm /W, L:7.7	N
	MH $>$ 405 W single-ended	$\eta$ : 79.3lm /W, L:7.7	N
	MH ceramic double-ended	$\eta$ : 84.5lm /W, L:7.7	N
	MH quartz double-ended	$\eta$ : 79.3 lm /W, L:12.3	N
	Organic light-emitting diode (OLED)	$\eta$ : 65.0 lm /W, L:1.5	N
	Until 1 September 2023: HL G9, G4 and GY6.35	$\eta$ : 19.5lm /W, L:7.7	N
	HL R7s $\leq$ 2 700 lm	$\eta$ : 26.0 lm /W, L:13.0	N
	Other light sources in scope not mentioned above	$\eta$ : 120 lm /W, L:1.5 (*)	P
	(*)For connected light sources (CLS) a factor L = 2,0 shall be applied		N
1.1.4	correction factor (C) depending on light source type, and additions to C for special light source features are specified		P
	Non-directional (NDLS) not operating on mains (NMLS)	Basic C value 1.00	P
	Non-directional (NDLS) operating on mains (MLS)	Basic C value 1.08	N
	Directional (DLS) not operating on mains (NMLS)	Basic C value 1.15	N
	Directional (DLS) operating on mains (MLS)	Basic C value 1.23	N
	Special light source feature		N
	FL or HID with CCT $>$ 5 000 K	Bonus on C +0.10	N

## (EU) 2019/2020

Clause	Requirement + Test	Result - Remark	Verdict
	FL with CRI > 90	Bonus on C 0.10	N
	HID with second envelope	Bonus on C +0.10	N
	MH NDLS > 405 W with non-clear envelope	Bonus on C +0.10	N
	DLS with anti-glare shield	Bonus on C +0.20	N
	Colour-tuneable light source (CTLS)	Bonus on C +0.10	N
	High luminance light sources (HLLS)	Bonus on C +0,005•Luminance- HLLS - 0,0167	N
1.2	Standby power – Light Source		N
	The standby power $P_{sb}$ of a light source shall not exceed 0.5 W		N
	The networked standby power $P_{net}$ of a connected light source shall not exceed 0.5 W		N
	The allowable values for $P_{sb}$ and $P_{net}$ shall not be added together		N
1.3	Energy Efficiency Requirements – Separate Control Gear (at full-load)		N
	Control gear for LED or OLED light sources: $P_{cg0,81} / (1,09 \times P_{cg0,81} + 2,10)$		N
	The no-load power $P_{no}$ of a separate control gear shall not exceed 0.5 W		N
	The standby power $P_{sb}$ of a separate control gear shall not exceed 0.5 W		N
	The networked standby power $P_{net}$ of a connected separate control gear shall not exceed 0.5 W		N
	The allowable values for $P_{sb}$ and $P_{net}$ shall not be added together		N
2	Functional Requirements – Light Source (Table 4)		P
2.1	Colour Rendering Index CRI: $\geq 80$		P
2.2	Displacement Factor (DF, $\cos \phi_1$ ) at Power Input $P_{on}$ for LED and OLED MLS:		N
	No limit at $P_{on} \leq 5$ W DF $\geq 0.5$ at $5$ W < $P_{on} \leq 10$ W, DF $\geq 0.7$ at $10$ W < $P_{on} \leq 25$ W DF $\geq 0.9$ at $25$ W < $P_{on}$		N

(EU) 2019/2020			
Clause	Requirement + Test	Result - Remark	Verdict
2.3	Lumen Maintenance Factor (for LED and OLED): $X_{LMF,MIN}\% = 100 \times e^{\frac{(3000 \times \ln(0.7))}{L_{70}}}$	See Appendix I table 3	P
2.4	Survival Factor (for LED and OLED): At least 9 light sources of the test sample must be operational after completing the test in Annex V of this Regulation.	See Appendix I table 3	P
2.5	Colour consistency for LED and OLED light sources: Variation of chromaticity coordinates within a six-step MacAdam ellipse or less.	See Appendix I table 1	P
2.6	Flicker for LED and OLED MLS: Pst LM ≤ 1.0 at full-load	See Appendix I table 1	N
2.7	Stroboscopic effect for LED and OLED MLS: SVM ≤ 0.9 at full-load; From 1 September 2024 SVM ≤ 0.4 at full-load	See Appendix I table 1	N
3	Information requirements		P
3.(a)	Information to be displayed on the light source itself		P
	For all light sources, except CTLS, LFL, CFLni, other FL, and HID, the value and physical unit of the useful luminous flux (lm) and correlated colour temperature (K) shall be displayed in a legible font on the surface if, after the inclusion of safety-related information, there is sufficient space available for it without unduly obstructing the light emission.		P
	For directional light sources, the beam angle (°) shall also be indicated.		N
	If there is room for only two values, the useful luminous flux and the correlated colour temperature shall be displayed. If there is room for only one value, the useful luminous flux shall be displayed.		P
3.(b)	Information to be visibly displayed on the packaging		P
3.(b)(1)	Light source placed on the market, not in a containing product		P
	(a) Useful luminous flux (lm): - In a font at least twice as large as the display of the on-mode power (P <sub>on</sub> ) - Clearly indicating if it refers to the flux in a sphere (360°), in a wide cone (120°) or in a narrow cone (90°)		P
	(b) Correlated Colour Temperature, rounded to the nearest 100 K		P
	(c) Beam angle in degrees For directional light sources		N
	(d) electrical interface details, e.g. cap- or connector-type, type of power supply (e.g. 230 V AC 50 Hz, 34.5 V DC)		P
	(e) L <sub>70</sub> B <sub>50</sub> lifetime for LED and OLED light sources, expressed in hours		P

## (EU) 2019/2020

Clause	Requirement + Test	Result - Remark	Verdict
	(f) on-mode power (Pon), expressed in W		N
	(g) standby power (Psb), expressed in W and rounded to the second decimal. If the value is zero, it may be omitted from the packaging		N
	(h) networked standby power (Pnet) for CLS, expressed in W and rounded to the second decimal. If the value is zero, it may be omitted from the packaging		N
	(i) Colour Rendering Index, rounded to the nearest integer		P
	(j) Clear indication to this effect, if CRI < 80, and the light source is intended for use in outdoor applications, industrial applications or other applications where lighting standards allow a CRI < 80.		N
	(k) Information on non-standard conditions (such as ambient temperature $T_a \neq 25 \text{ }^\circ\text{C}$ or specific thermal management is necessary)		P
	(l) a warning if the light source cannot be dimmed or can be dimmed only with specific dimmers or with specific wired or wireless dimming methods. In the latter cases a list of compatible dimmers and/or methods shall be provided on the manufacturer's website		N
	(m) if the light source contains mercury: a warning of this, including the mercury content in mg rounded to the first decimal place		N
	(n) if the light source is within the scope of Directive 2012/19/EU, without prejudice to marking obligations pursuant to Article 14(4) of Directive 2012/19/EU, or contains mercury: a warning that it shall not be disposed of as unsorted municipal waste		N
3.(b)(2)	Separate control gears For separate control gear placed on the market as a stand-alone product, not as a part of a containing product		N
	(a) the maximum output power of the control gear (for HL, LED and OLED) or the power of the light source for which the control gear is intended (for FL and HID)		N
	(b) the type of light source(s) for which it is intended		N
	(c) the efficiency in full-load, expressed in percentage		N
	(d) the no-load power (Pno), expressed in W and rounded to the second decimal, or the indication that the gear is not intended to operate in no-load mode. If the value is zero, it may be omitted from the packaging but shall nonetheless be declared in the technical documentation and on websites		N
	(e) the standby power (Psb), expressed in W and rounded to the second decimal. If the value is zero, it may be omitted from the packaging but shall nonetheless be declared in		N
	(f) the networked standby power (Pnet), expressed in W and rounded to the second decimal. If the value is zero, it may be omitted from the packaging but shall nonetheless be declared in the technical documentation and on websites		N

(EU) 2019/2020			
Clause	Requirement + Test	Result - Remark	Verdict
	(g) a warning if the control gear is not suitable for dimming of light sources or can be used only with specific types of dimmable light sources or using specific wired or wireless dimming methods. In the latter cases, detailed information on the conditions in which the control gear can be used for dimming shall be provided on the manufacturer's or importer's website		N
	(h) a QR-code redirecting to a free-access website of the manufacturer, importer or authorised representative, or the internet address for such a website, where full information on the control gear can be found		N
3.(c)	Information to be visibly displayed on a free-access website of the manufacturer, importer or authorised representative		N
3.(c)(1)	Separate control gears For any separate control gear that is placed on the EU market, the following information shall be displayed on at least one free-access website:		N
	(a) the information specified in point 3(b)(2), except 3(b)(2)(h)		N
	(b) the outer dimensions in mm		N
	(c) the mass in grams of the control gear, without packaging, and without lighting control parts and non-lighting parts, if any and if they can be physically separated from the control gear		N
	(d) instructions on how to remove lighting control parts and non-lighting parts, if any, or how to switch them off or minimise their power consumption during control-gear testing for market surveillance purposes		N
	(e) if the control gear can be used with dimmable light sources, a list of minimum characteristics that the light sources should have to be fully compatible with the control gear during dimming, and possibly a list of compatible dimmable light sources		N
	(f) recommendations on how to dispose of it at		N
3(d)	Technical documentation		N
	Separate control gears:		N
	The information specified in point 3(c)(2) of this Annex shall also be contained in the technical documentation file drawn up for the purposes of conformity assessment pursuant to Article 8 of Directive 2009/125/EC.		N



(EU) 2019/2015																			
Clause	Requirement + Test	Result - Remark	Verdict																
<b>ANNEX III</b>	<b>Energy efficiency classes and calculation method</b>		P																
	The energy efficiency class of the lamp is calculated as follows and rounded to two decimal places: $\eta_{TM} = (\Phi_{use}/P_{on}) \times FTM (lm/W).$		P																
	$\eta_{TM} = (\Phi_{use}/P_{on}) \times FTM (lm/W).$		P																
	$\Phi_{use}$ :		P																
	$P_{on}$ :		P																
	$FTM$ :	0.926	P																
	Non-directional (NDLS) operating on mains (MLS) : Factor FTM * 1,000		N																
	Non-directional (NDLS) not operating on mains (NMLS) : Factor FTM * 0,926		P																
	Directional (DLS) operating on mains (MLS) : Factor FTM * 1,176x		N																
	Directional (DLS) not operating on mains (NMLS) : Factor FTM * 1,089		N																
	The maximum $\eta_{TM}$ of lamps:	See Appendix I table 2	P																
	Energy efficiency classes		P																
	The energy efficiency class of light sources shall be determined as set out in Table 1,		P																
	<p style="text-align: center;"><small>Table 1</small> Energy efficiency classes of light sources</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Energy efficiency class</th> <th style="text-align: center;">Total mains efficacy <math>\eta_{TM}</math> (lm/W)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">A</td> <td style="text-align: center;"><math>210 \leq \eta_{TM}</math></td> </tr> <tr> <td style="text-align: center;">B</td> <td style="text-align: center;"><math>185 \leq \eta_{TM} &lt; 210</math></td> </tr> <tr> <td style="text-align: center;">C</td> <td style="text-align: center;"><math>160 \leq \eta_{TM} &lt; 185</math></td> </tr> <tr> <td style="text-align: center;">D</td> <td style="text-align: center;"><math>135 \leq \eta_{TM} &lt; 160</math></td> </tr> <tr> <td style="text-align: center;">E</td> <td style="text-align: center;"><math>110 \leq \eta_{TM} &lt; 135</math></td> </tr> <tr> <td style="text-align: center;">F</td> <td style="text-align: center;"><math>85 \leq \eta_{TM} &lt; 110</math></td> </tr> <tr> <td style="text-align: center;">G</td> <td style="text-align: center;"><math>\eta_{TM} &lt; 85</math></td> </tr> </tbody> </table>	Energy efficiency class	Total mains efficacy $\eta_{TM}$ (lm/W)	A	$210 \leq \eta_{TM}$	B	$185 \leq \eta_{TM} < 210$	C	$160 \leq \eta_{TM} < 185$	D	$135 \leq \eta_{TM} < 160$	E	$110 \leq \eta_{TM} < 135$	F	$85 \leq \eta_{TM} < 110$	G	$\eta_{TM} < 85$	See Appendix I table 2	P
Energy efficiency class	Total mains efficacy $\eta_{TM}$ (lm/W)																		
A	$210 \leq \eta_{TM}$																		
B	$185 \leq \eta_{TM} < 210$																		
C	$160 \leq \eta_{TM} < 185$																		
D	$135 \leq \eta_{TM} < 160$																		
E	$110 \leq \eta_{TM} < 135$																		
F	$85 \leq \eta_{TM} < 110$																		
G	$\eta_{TM} < 85$																		

## Appendix I: Test Data Sheet

Table 1:

For model COB028						
Sample No.	Measured Pon (W)	Measured Φuse (lm)	Ponmax (W)	Displacement factor (DF)	Psb (W)	Pnet (W)
1#	14.47	2127.71	20.43	--	--	--
2#	14.18	2106.43	20.30	--	--	--
3#	14.90	2148.99	20.57	--	--	--
4#	14.61	2142.60	20.54	--	--	--
5#	14.79	2166.01	20.88	--	--	--
6#	14.77	2117.07	20.46	--	--	--
7#	14.92	2151.11	20.72	--	--	--
8#	14.85	2140.48	20.54	--	--	--
9#	14.64	2155.37	20.77	--	--	--
10#	14.70	2155.37	20.71	--	--	--
Average	14.68	2141.11	20.59	--	--	--
<b>Required</b>	--	--	--	--	--	--
Sample No.	CRI	R9	CCT (K)	SDCM	Pst LM	SVM
1#	90.0	60	5800	3.5	--	--
2#	90.5	62	5858	3.7	--	--
3#	89.6	61	5829	3.5	--	--
4#	89.8	59	5759	3.9	--	--
5#	90.9	61	5852	3.5	--	--
6#	91.0	62	5887	3.6	--	--
7#	90.6	63	5841	3.3	--	--
8#	89.9	59	5771	3.7	--	--
9#	90.7	62	5864	3.5	--	--
10#	90.3	61	5771	3.9	--	--
Average	90.3	61	5823	3.6	--	--
<b>Required</b>	≥ 80	--	--	≤ 6	≤ 1.0	≤ 0.9 ≤ 0.4(from 2024.9.1)

$P_{onmax} = C \times (L + \Phi_{use} / (F \times \eta)) \times R$					
Correction factor	C	1.00	Efficacy factor	F	1.00
End loss factor (W)	L	1.5	Threshold efficacy (lm/W)	η	120
Useful luminous (lm)	Φ <sub>use</sub>	See measured Φ <sub>use</sub>	CRI factor	R	(CRI + 80)/160

Table 2:

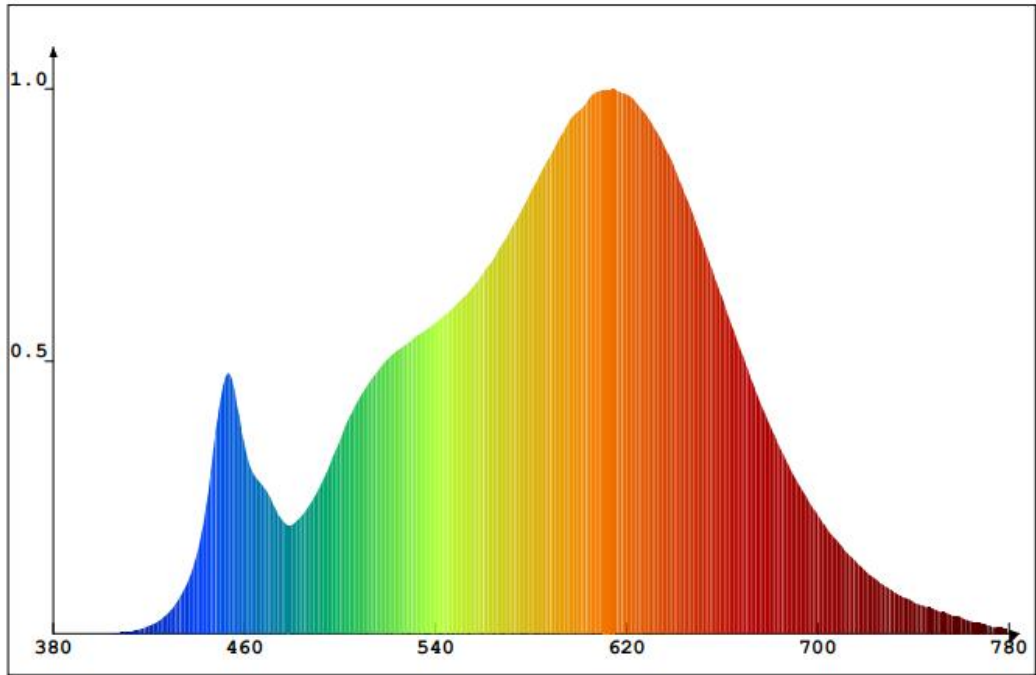
For model COB028									
Sample No.	Measured Φuse (lm)	Declared Φuse (lm)	Measured Pon (W)	Declared Pon (W)	F <sub>TM</sub>	Declared η <sub>TM</sub> (lm/W)	Measured η <sub>TM</sub> (lm/W)	Energy efficiency class basing on declared values	Energy efficiency class basing on measured values
1#	2127.71	2200	14.47	15	0.926	135.81	136.16	--	--
2#	2106.43	2200	14.18	15	0.926	135.81	137.55	--	--
3#	2148.99	2200	14.90	15	0.926	135.81	133.52	--	--
4#	2142.60	2200	14.61	15	0.926	135.81	135.76	--	--
5#	2166.01	2200	14.79	15	0.926	135.81	135.63	--	--
6#	2117.07	2200	14.77	15	0.926	135.81	132.69	--	--
7#	2151.11	2200	14.92	15	0.926	135.81	133.52	--	--
8#	2140.48	2200	14.85	15	0.926	135.81	133.51	--	--
9#	2155.37	2200	14.64	15	0.926	135.81	136.30	--	--
10#	2155.37	2200	14.70	15	0.926	135.81	135.76	--	--
Average	2141.11	2200	14.68	15	0.926	135.81	135.02	D	D
<b>Energy efficiency class:</b>					<b>Factors F<sub>TM</sub> by light source type:</b>				
A: 210 ≤ η <sub>TM</sub>					<input type="checkbox"/> NDLS & MLS: 1,00				
B: 185 ≤ η <sub>TM</sub> < 210					<input checked="" type="checkbox"/> NDLS & NMLS: 0,926				
C: 160 ≤ η <sub>TM</sub> < 185					<input type="checkbox"/> DLS & MLS: 1,176				
D: 135 ≤ η <sub>TM</sub> < 160					<input type="checkbox"/> DLS & NMLS: 1,089				
E: 110 ≤ η <sub>TM</sub> < 135									
F: 85 ≤ η <sub>TM</sub> < 110									
G: η <sub>TM</sub> < 85									

Table 3:

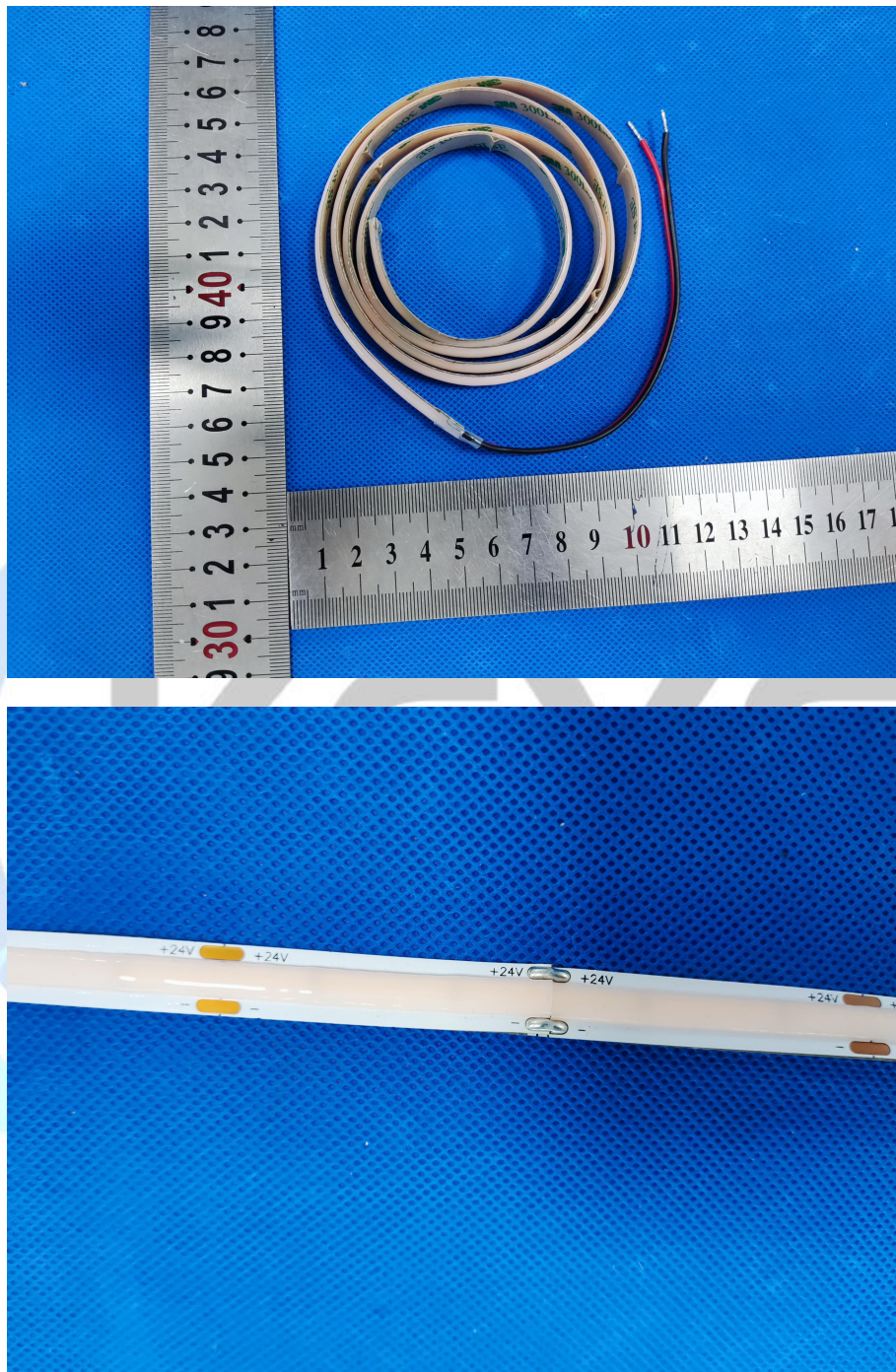
For model COB028								
Sample No.	Initial Φuse (lm)	3600H Φuse (lm)	X <sub>LMF,MIN</sub> % at 3600H	Survival factor at 3600H	Measured beam angle (°)	Measured I <sub>max</sub> (cd)	Chromaticity coordinates x	Chromaticity coordinates y
1#	2127.71	2013.50	94.63%	100%	--	--	0.4438	0.4112
2#	2106.43	2023.57	96.07%	100%	--	--	0.4527	0.4174
3#	2148.99	2030.61	94.49%	100%	--	--	0.4451	0.4133
4#	2142.60	2025.58	94.54%	100%	--	--	0.4416	0.4075
5#	2166.01	2046.72	94.49%	100%	--	--	0.4482	0.4165
6#	2117.07	1999.41	94.44%	100%	--	--	0.4447	0.4116
7#	2151.11	2031.22	94.43%	100%	--	--	0.4456	0.4096
8#	2140.48	2029.61	94.82%	100%	--	--	0.4465	0.4137
9#	2155.37	2033.43	94.34%	100%	--	--	0.4429	0.4108
10#	2155.37	2039.68	94.63%	100%	--	--	0.4407	0.4100
Average	2141.11	2027.33	94.69%	100%	--	--	0.4452	0.4121
Required	--	--	≥93.12%	≥ 90%	--	--	--	--

Table 4:

Appendix I: Spectral power distribution



### Appendix II: Photos of Tested Samples



--End of Report--