WARSAW UNIVERSITY OF TECHNOLOGY
The Faculty of Power and Aeronautical Engineering
Institute of Aeronautics and Applied Mechanics

Report

„Test to determine the coefficient Cx (SCx) at 150 km / h for the URBANO LED family and the URBINO LED family by the LUG manufacturer”

Authors:
mgr inż. Stanisław Gradolewski

Director of the Institute

Prof. dr hab. inż. Krzysztof Arczewski

Digitally signed by Oprea Nicolae
Date: 2019.02.25 16:37:13 EET
Reason: MoldSign Signature
Location: Moldova

Warsaw, March 2018

1. Aim of the project.

The aim of this study was to determine the drag coefficient Cx and observe the effects of wind pressure for the luminaires URBANO LED and URBINO LED.

Image No. 1 and 2. View of the luminaires

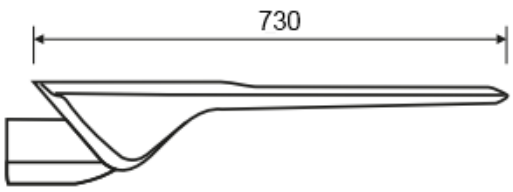
URBANO LED

URBINO LED

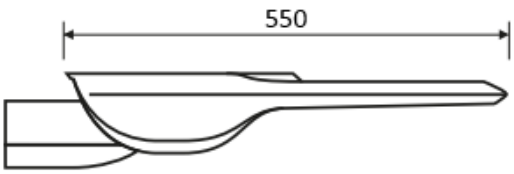
Source: LUG materials

Figure No. 1. A side projection of the luminaires

URBANO LED



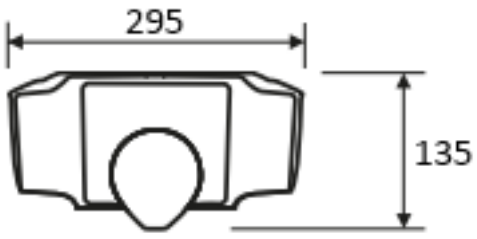
URBINO LED



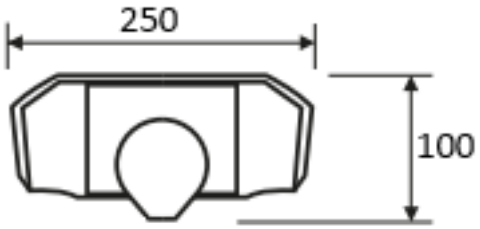
Source: LUG materials

Figure No. 2. A back projection of the luminaires

URBANO LED



URBINO LED



1. *Source: LUG materials*

2. Measurement

2.1. Coefficient Cx measurement

Between 09 – 27 February 2018, the measurement were conducted in order to determine the air resistance coefficient *Cx* for inflow directed from the front, side and back of the luminaire series URBANO LED and URBINO LED, manufactured by LUG Light Factory.

The measurements were taken in Tunnel No. 1 of the Warsaw University of Technology Institute of Aerodynamics. The tunnel with a diameter measuring 1.16 m wos equipped with the Witoszyński weight, where the resistance force Px was measured. Received measurements of the Px power were used to calculate the air resistance coefficient Cx.

Figures 3, 4 and 5 present schematic circuit measurement and images from 3 to 14 illustrate the suspension of the luminaire for each setting.

The first setting was designed to determine the Cx coefficient for the luminaire flown around from the front (Figure No 3 and Image from 3 to 6), which corresponds to the smallest cross-sectional area. The second setting shows change of the suspension and flow around from the side of the frame (Figure No 4 and Image from 7 to 10) – setting with the largest cross-sectional area.

The measuring system is shown in Figures No 3, 4 and 5 and consisted of the following elements in sequence:

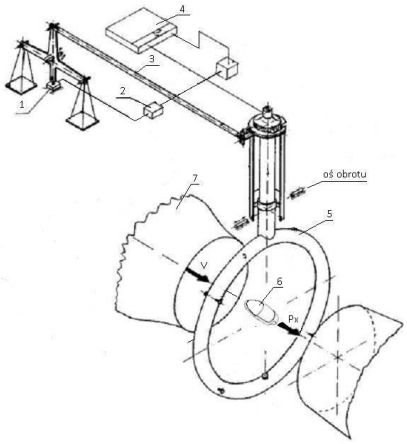
1. train gauge force transducer,
2. amplifier,
3. lever system,
4. computer
5. frame weight,
6. luminaire model,
7. wind tunnel.

Luminaire tested in a wind tunnel was attached with wires to the frame which covers the measuring space. Method of attachment is shown in Images from 3 to 14, and schematically in Figures No 3, 4 and 5. Wires binding luminaire to the frame transfer all the forces occurring in the model to the frame, including the tested force Px.

The Px resistance force acting on the model due the frame weight and lever system is transferred to the strain gauge force transducer. From the transducer the resistance force Px value is transmitted through the amplifier to the computer, due to which it can be read.

Flow from the front

Figure No 3



Source: own materials

URBANO luminaire

Image No 3 with horizontal mounting

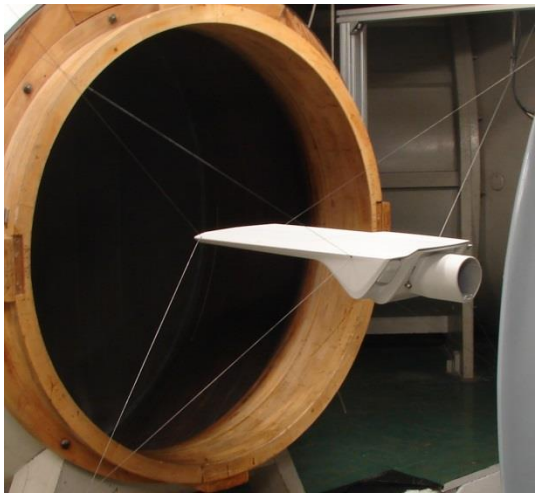
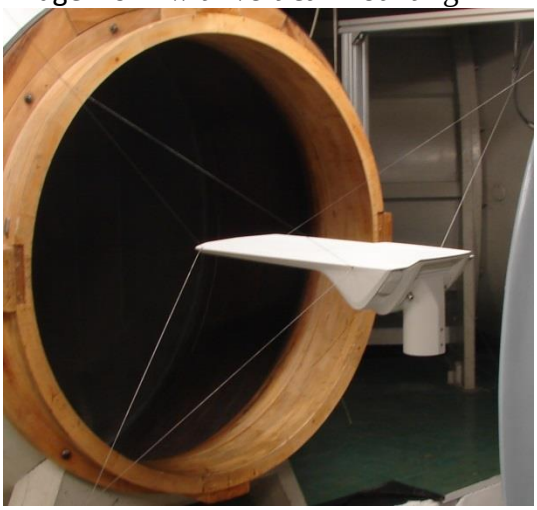


Image No 4 with vertical mounting



URBINO luminaire

Image No 5 with horizontal mounting

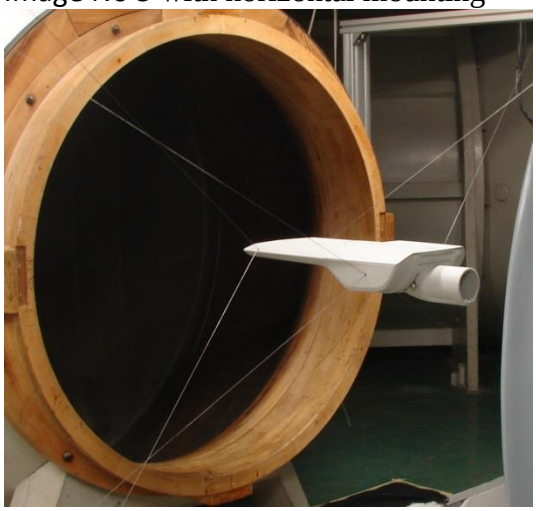


Image No 6 with vertical mounting

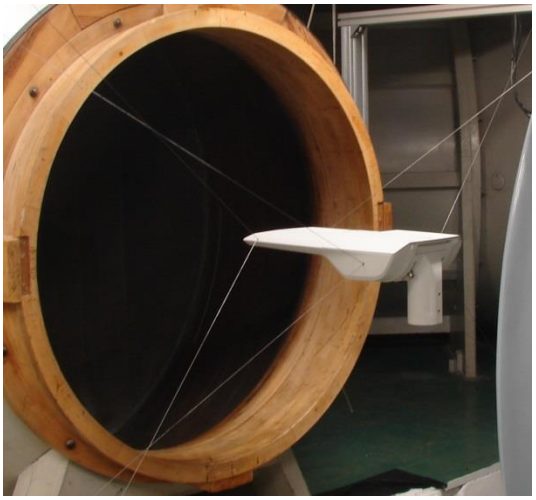
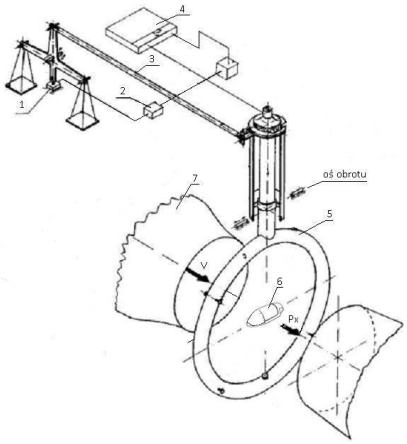


Photo: Stanisław Gradolewski

Flow from the side

Figure No 4



Source: own materials

URBANO luminaire

Image No 7 with horizontal mounting

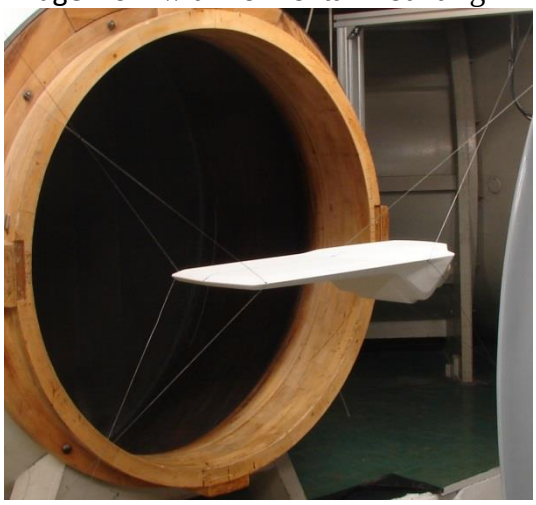
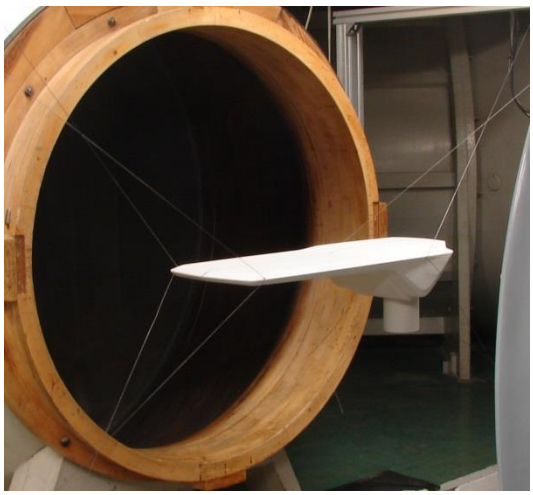


Image No 8 with vertical mounting



URBINO luminaire

Image No 9 with horizontal mounting

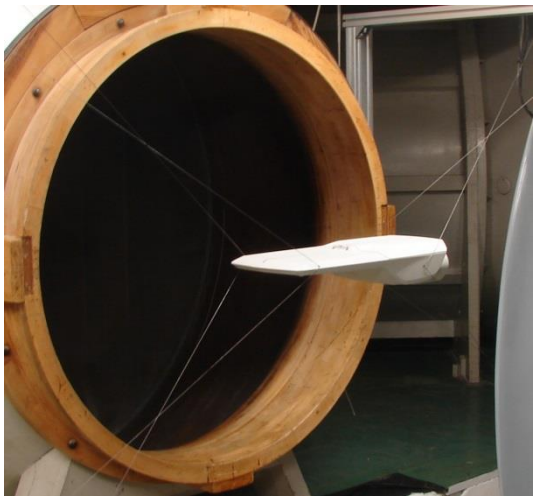


Image No 10 with vertical mounting

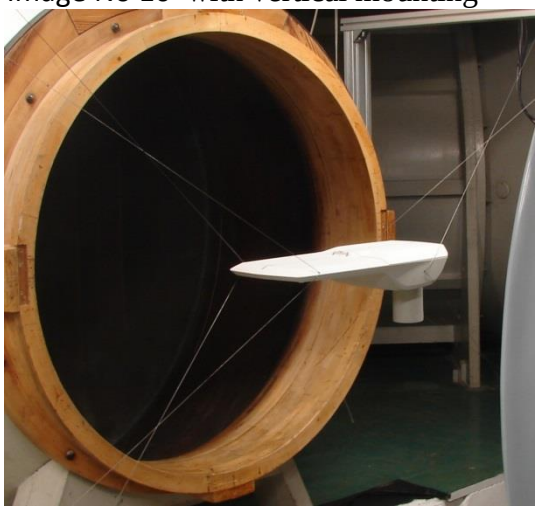
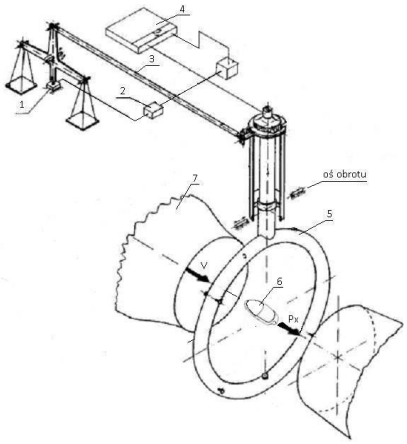


Photo: Stanisław Gradolewski

Flow from the behind

Figure No 5



Source: own materials

URBANO luminaire

Image No 11 with horizontal mounting

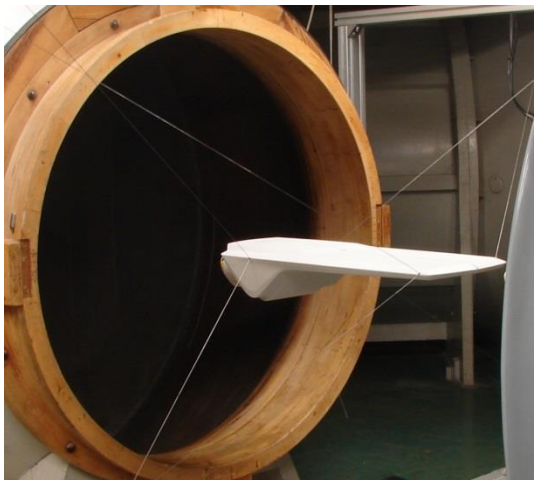
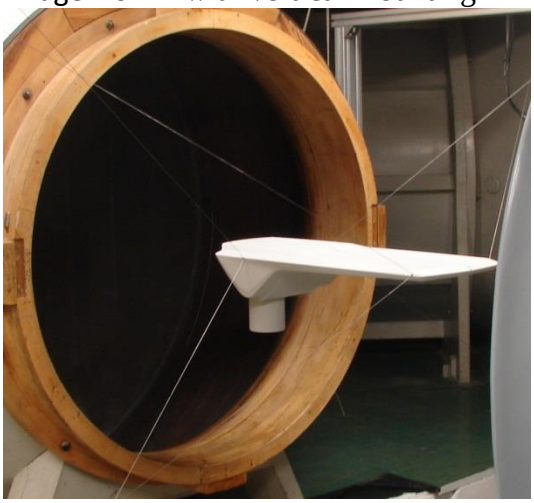


Image No 12 with vertical mounting



URBINO luminaire

Image No 13 with horizontal mounting

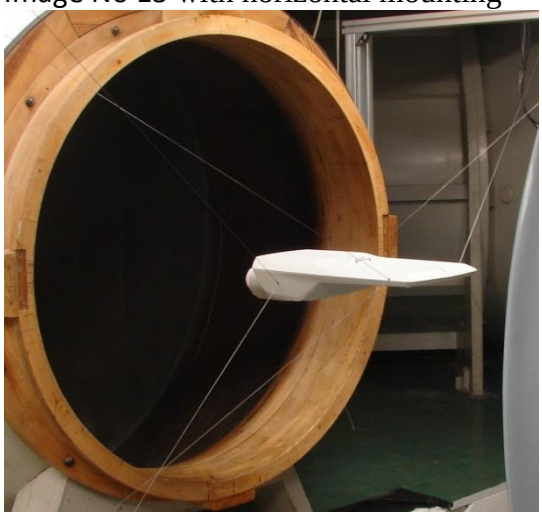


Image No 14 with vertical mounting

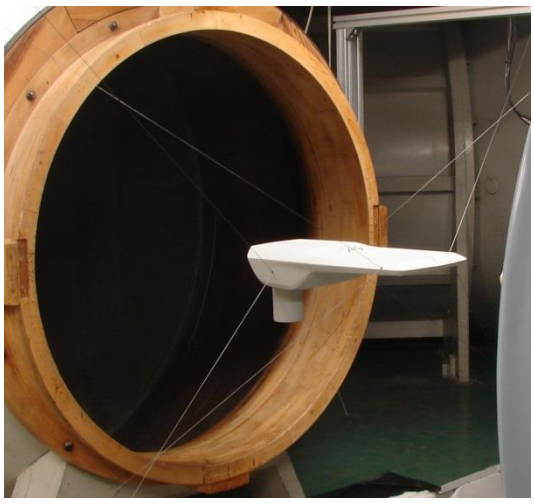


Photo: Stanisław Gradolewski

3. The results of measurements

3.1. Determination of coefficient Cx

The results of measurements and calculations are shown in Table No 1.

The measured Px force is gross volume. Cx calculations take into account the correction for the tare weight and the forces acting on the wires securing the luminaire.

.

Table No 1. The results of measurements and calculations for three settings

			The luminaire URBANO									
Day parameters			from the side					fron the side (fastening down)				
	P_{atm}	hPa	1006.5									
	t_{atm}	°C	21									
	T_{atm}	K	293.15									
	R	$m^2/(s^2K)$	287									
	r	kg/m^3	1.192238									
Measurements	V	mmH_2O	39	55	76	100	110	39	55	76	100	110
		m/s	25.33	30.08	35.37	40.57	42.55	25.33	30.08	35.37	40.57	42.55
	S	m^2	0.049					0.039				
	P_x	N	13.8	20.5	29.1	38	42.6	14	21	29	38.5	42.7
	arm + wires	N	2.5	3.2	4.75	6.9	7.9	2.5	3.2	4.75	6.9	7.9
Results	C_x*S	m^2	0.030	0.032	0.033	0.032	**0.032**	0.030	0.033	0.033	0.032	**0.032**
	Cx		0.603	0.654	0.667	0.647	**0.654**	0.613	0.673	0.664	0.657	**0.658**

			The luminaire URBANO																			
Day parameters			from the front					from the front (fastening down)					from behind					from behind (fastening down)				
	P_{atm}	hPa	1004										1006.5									
	t_{atm}	°C	21.5										21									
	T_{atm}	K	294.65										294.15									
	R	$m^2/(s^2K)$	287										287									
	r	kg/m^3	1.187259										**1.1922**									
Measurements	V	mmH_2O	39	55	76	100	110	39	55	76	100	110	39	55	76	100	110	39	55	76	100	110
		m/s	25.4	30.1	35.4	40.7	42.6	25.4	30.1	35.4	40.7	42.6	25.33	30.08	35.37	40.57	42.55	25.33	30.08	35.37	40.57	42.55
	S	m^2	0.039					0.047					0.039					0.047				
	P_x	N	8.4	11.5	16.1	21.8	24.3	11.8	17.3	24.3	32	35	10.5	13.2	21.5	29.1	32.5	12.4	17.8	24.5	33.5	37
	arm + wires	N	2.5	3.2	4.75	6.9	7.9	2.5	3.2	4.75	6.9	7.9	2.5	3.2	4.75	6.9	7.9	2.5	3.2	4.75	6.9	7.9
Results	C_x*S	m^2	0.015	0.015	0.015	0.015	**0.015**	0.024	0.026	0.026	0.025	**0.025**	0.014	0.019	0.022	0.023	**0.023**	0.026	0.027	0.026	0.027	**0.027**
	Cx		0.392	0.391	0.387	0.386	**0.386**	0.618	0.664	0.666	0.650	**0.638**	0.367	0.473	0.573	0.577	**0.582**	0.547	0.572	0.560	0.573	**0.570**

			The luminaire URBINO									
Day parameters			from the side					fron the side (fastening down)				
	P_{atm}	hPa	996									
	t_{atm}	°C	20									
	T_{atm}	K	293.15									
	R	$m^2/(s^2K)$	287									
	r	kg/m^3	1.183825098									
Measurements	V	mmH_2O	39	55	76	100	110	39	55	76	100	110
		m/s	25.4	30.2	35.5	40.7	42.7	25.4	30.2	35.5	40.7	42.7
	S	m^2	0.039					0.039				
	P_x	N	11.3	15.6	21.9	29.5	32.8	12.2	17.1	24	32.4	36
	arm + wires	N	2.5	3.2	4.75	6.9	8	2.5	3.2	4.75	6.9	7.9
Results	C_x*S	m^2	0.023	0.023	0.023	0.023	0.023	0.025	0.026	0.026	0.026	0.026
	Cx		0.590	0.589	0.590	0.591	0.589	0.650	0.661	0.662	0.667	0.668

			The luminaire URBINO																			
Day parameters			from the front					from the front (fastening down)					from behind					from behind (fastening down)				
	P_{atm}	hPa	996																			
	t_{atm}	°C	20																			
	T_{atm}	K	293.15																			
	R	$m^2/(s^2K)$	287																			
	r	kg/m^3	1.183825098																			
Measurements	V	mmH_2O	39	55	76	100	110	39	55	76	100	110	39	55	76	100	110	39	55	76	100	110
		m/s	25.4	30.2	35.5	40.7	42.7	25.4	30.2	35.5	40.7	42.7	25.4	30.2	35.5	40.7	42.7	25.4	30.2	35.5	40.7	42.7
	S	m^2	0.0175					0.0246					0.0175					0.0246				
	P_x	N	5	6.4	9.1	13	14.2	9.1	12.4	17.9	24.1	27	7.1	9.5	13.5	18.5	20.5	8.85	12.2	17.2	23.2	25.8
	arm + wires	N	2.5	3.2	4.75	6.9	7.9	2.5	3.2	4.75	6.9	7.9	2.5	3.2	4.75	6.9	7.9	2.5	3.2	4.75	6.9	7.9
Results	C_x*S	m^2	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.017	0.017	0.017	0.017	0.017
	Cx		0.37	0.34	0.33	0.36	0.33	0.7	0.69	0.72	0.71	0.72	0.69	0.67	0.67	0.68	0.67	0.67	0.68	0.68	0.68	0.67

Abbreviations and formulas:

P_{atm} – atmospheric pressure. (in hPa)

t_{atm} – ambient temperature. (in °c)

T_{atm} – ambient temperature = t_{atm} + 273.15. (in K)

R – gas constant (287 $m^2/(s^2K)$)

ρ – air density = P_{atm} /(R* T_{atm}). (in kg/m^3)

Δp – dynamic pressure in the tunnel. (in mmH_2O)

V – speed of flow in the tunnel = $\sqrt{2\Delta p / \rho}$. (in m/s)

S – reference surface (in m^2)

Px – resistance force. (in N)

Cx – resistance coefficient $\frac{Px}{\frac{\rho V^2}{2} S}$.

Table No 1 presents measurement results for three settings: air stream from the front, side and back of the tested luminaires and pre-recorded parameters of the day. In the formula for Cx as the reference surface S appropriate rectangular cross-sections were used.

With the transformed formulas, based on the obtained measurements and parameters, resistance coefficients were calculated.

The determined resistance coefficients for flow (V=150 km/h) from the front, side and back are respectively:

The front	The front (fastening down)
URBANO: 0.39	0.64
URBINO: 0.33	0.72
The side	The side (fastening down)
URBANO: 0.65	0.66
URBINO: 0.59	0.67
The back	The back (fastening down)
URBANO: 0.58	0.57
URBINO: 0.67	0.67

PHOTOMETRIC TEST REPORT
LM-79 & EN 13032-4

LUG Light Factory Ltd ul. Gorzowska 11 65-127 Zielona Góra, POLAND KRS 0000290498 REGON 080212116 NIP PL 929-17-85-452	LUG Testing Laboratory address: ul. Nowa 7 66-002 Nowy Kisielin, POLAND	TEST SPECIFICATION – STANDARDS: PN – EN 13032-4:2015 IES LM-79-08
Test Report No. BF_13_5264_18	Tested by: Krzysztof Olek	Compiled by: Krzysztof Olek
Date: 2018-01-15	Approved by: Marcin Białas	Client name: G. Plasun LUG Light Factory
This protocol shall not be reproduced except in full without the written approval of the Laboratory. The results in this report apply to the test sample(s) mentioned above at the time of the testing period only and are not to be used to indicate applicability to other similar products.		

1. TABLE OF CONTENTS

2. LUMINAIRE DATA

Company:	LUG Light Factory		
Model name:	5264 URBINO PREMIUM LED DALI/ED 10050lm/740 O13 szary II klasa		
Index:	130252.6L112.011		
Sample No.:	043/01		
Power supply:	Tridonic LCA 120W 350-1050mA one4all		
LED current:	350 mA		
Light source:	ML1701402.W740.01A		
LED model:	CREE XPG-3 Bin: S4		
Optic:	Lens: PMMA O13		
Dimensions of luminaire:		**Dimensions of luminous area:**	
Length:	550 mm	Length:	200 mm
Width:	250 mm	Width:	190 mm
Height:	100 mm	C0-plane height:	0 mm
		C90-plane height:	0 mm
		C180-plane height:	0 mm
		C270-plane height:	0 mm

3. MEASUREMENT CONDITIONS AND STABILIZATION

Photometric method:	Spectro-goniometer type C-γ
Measurement type:	Absolute
Sample position during measurement:	Side
Measurement distance:	10,473 m
Ambient temperature:	25,0 ±1°C
Integrating time:	Automatic
Stabilization tolerance:	0,5%

N/A

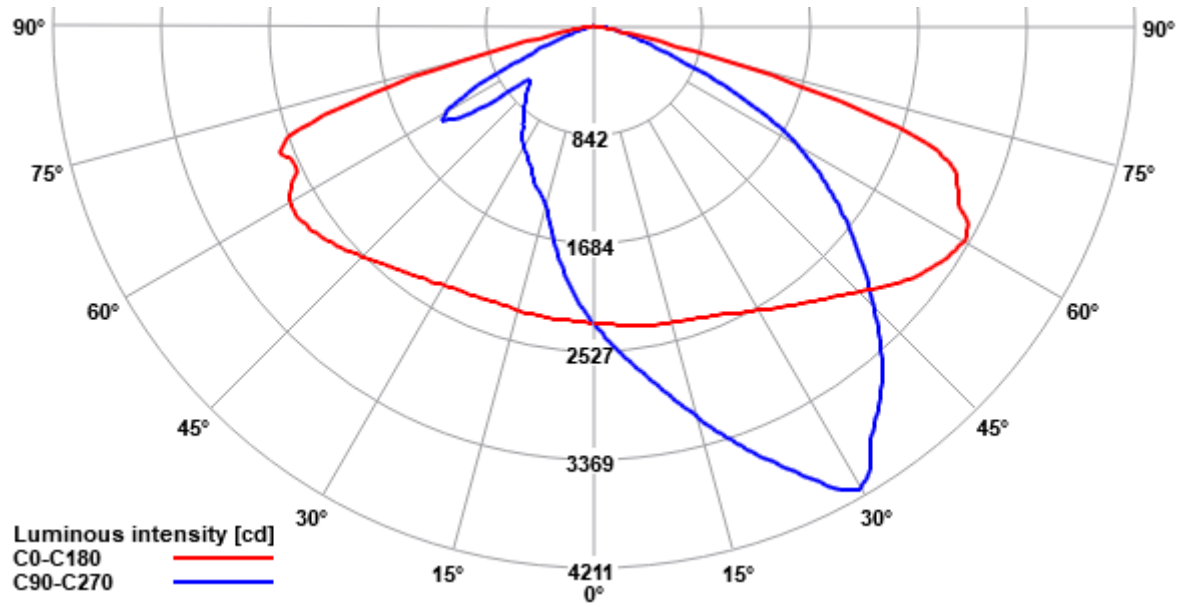
4. ELECTRICAL PARAMETERS

Voltage:	230,0 V
Frequency:	50,0 Hz
Current:	0,339 A
Active power:	75,7 W
Apparent power:	78,0 VA
Reactive power:	-19,0 var
Power factor:	0,970
Current THD:	N/A

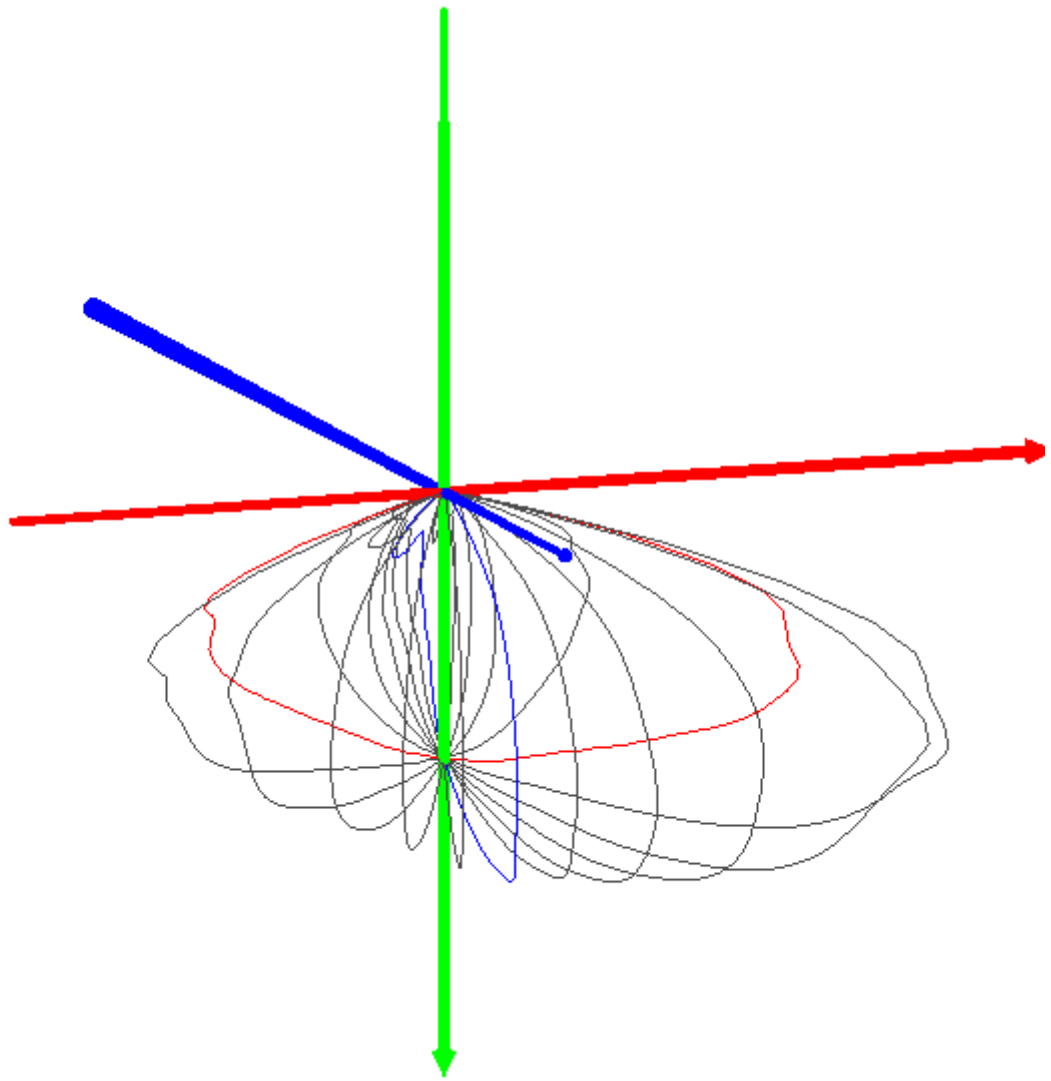
5. GONIOMETRIC MEASUREMENT RESULTS

Total luminous flux:	**10088,08 lm**
Light output ratio (LOR):	100,00%
Lower hemisphere output ratio (DLOR):	100,00%
Upper hemisphere output ratio (ULOR):	-0,00%
Maximum luminous intensity:	5090,51 cd
Luminous efficacy:	133,26 lm/W
Colour temperature:	3869 K
Colour rendering index:	71,58
Angular Colour Uniformity:	N/A

6. LIGHT INTENSITY DISTRIBUTION DIAGRAM



7. 3D CHART



Legend:		- C0-C180		- C90-C270		- G0-G180

8. UTILIZATION FACTORS

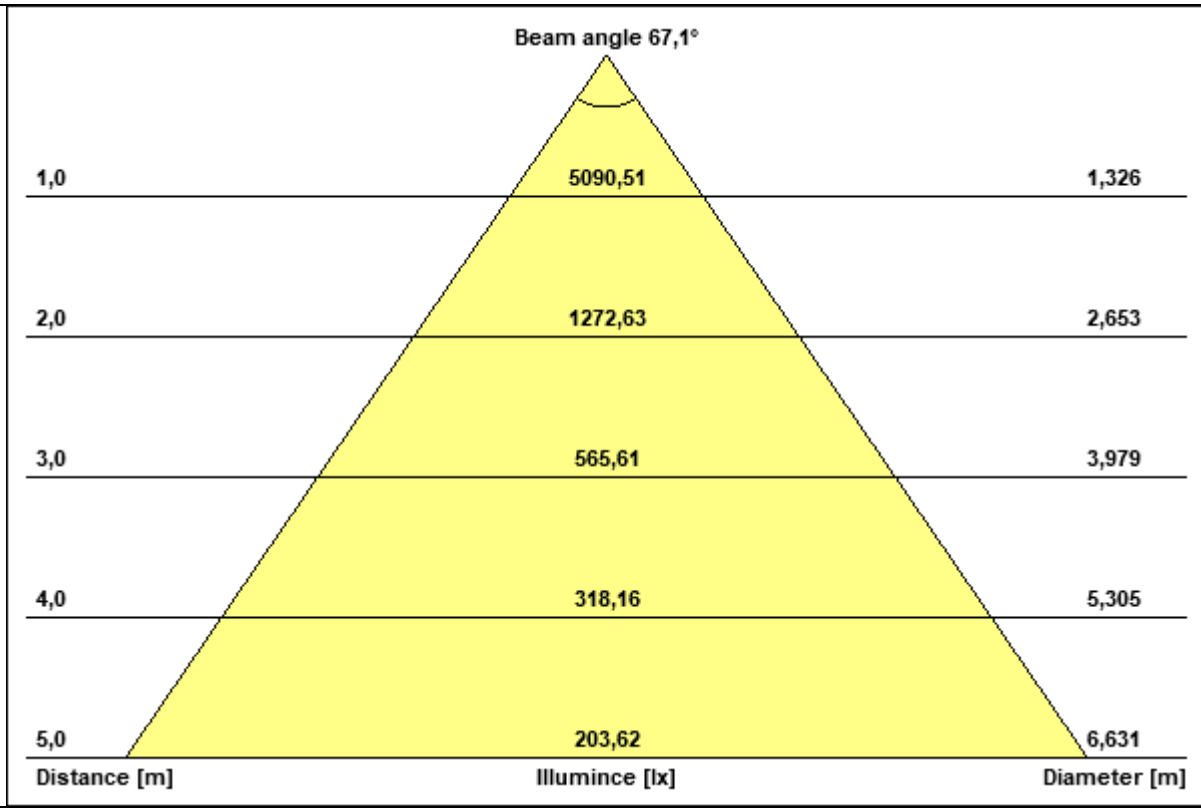
k = 0.60:	0,212	k = 2.00:	0,626
k = 0.80:	0,302	k = 2.50:	0,687
k = 1.00:	0,381	k = 3.00:	0,733
k = 1.25:	0,463	k = 4.00:	0,795
k = 1.50:	0,528	k = 5.00:	0,834

9. LUMINOUS INTENSITY [CD/KLM]

γ \ C	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°
0°	229,31	229,31	229,31	229,31	229,31	229,31	229,31	229,31	229,31	229,31	229,31	229,31
2°	230,20	232,31	234,47	236,98	237,67	234,81	239,02	239,27	237,13	235,39	233,14	231,07
4°	230,90	235,67	240,06	244,63	247,06	245,01	249,08	247,73	245,92	241,75	237,32	231,23
6°	231,95	239,41	246,14	252,49	256,26	254,84	258,71	257,53	254,25	248,50	241,95	234,83
8°	232,91	243,43	252,72	261,75	265,93	265,60	269,74	267,13	262,44	255,71	246,61	236,74
10°	234,20	247,02	259,53	270,09	276,90	276,51	280,73	277,53	271,83	263,19	251,71	239,32
12°	235,77	251,66	266,69	279,23	287,33	288,60	293,36	289,08	281,86	270,16	257,28	242,50
14°	236,15	255,65	274,03	289,73	300,48	301,51	305,86	301,04	292,55	278,41	262,38	245,26
16°	237,17	260,13	281,61	300,35	312,47	315,11	320,36	314,28	303,28	287,43	268,38	248,12
18°	238,26	265,61	290,87	312,98	326,50	329,78	334,04	326,59	314,74	297,28	273,94	251,39
20°	239,83	271,68	301,15	324,98	340,17	342,45	347,71	339,80	325,87	306,30	281,65	255,17
22°	241,67	278,42	311,70	337,85	353,17	355,98	361,26	352,29	337,17	316,48	289,96	260,80
24°	243,66	285,93	323,59	350,89	365,94	368,62	375,15	365,22	347,76	326,48	298,18	264,40
26°	246,85	293,82	335,25	363,06	378,73	382,29	389,15	377,59	359,07	335,79	306,92	270,15
28°	250,23	302,75	347,21	375,80	391,91	396,64	405,98	391,77	369,57	345,15	316,25	276,05
30°	252,92	312,07	359,45	388,54	404,03	408,14	413,29	402,34	380,00	354,98	325,16	282,26
32°	257,64	321,87	372,03	401,01	414,83	408,67	403,38	399,46	388,81	364,13	334,22	289,99
34°	261,11	332,13	384,69	413,99	422,10	398,40	383,79	386,03	393,01	373,26	343,76	297,32
36°	266,17	343,95	398,75	425,74	423,40	388,05	372,11	374,44	390,56	382,41	353,83	305,83
38°	270,16	355,78	413,22	436,58	421,67	379,66	361,02	364,72	385,77	390,01	364,83	314,46
40°	275,51	367,31	426,22	444,55	417,44	369,37	347,33	352,84	381,13	396,61	376,23	324,68
42°	280,44	379,45	438,85	449,86	412,06	355,61	331,80	339,90	373,50	399,99	387,32	334,43
44°	286,79	392,80	448,94	450,82	402,85	340,49	315,15	324,71	363,91	400,49	397,02	345,92
46°	293,73	404,97	458,27	449,43	389,62	322,20	298,09	308,98	350,03	397,34	405,30	356,23
48°	301,39	415,65	464,93	444,55	373,18	304,99	281,48	292,35	333,99	390,65	410,03	366,08
50°	308,30	425,82	469,66	438,46	353,73	288,39	265,80	276,87	314,95	380,69	412,12	374,34
52°	314,83	433,93	473,73	433,27	334,36	272,63	249,71	261,76	296,57	368,67	410,82	380,59
54°	320,46	440,51	477,65	425,75	316,71	256,45	233,80	245,99	277,93	353,90	409,38	384,29
56°	324,53	445,62	481,34	417,56	300,29	239,56	217,07	229,07	260,06	337,84	408,06	385,36
58°	328,70	453,64	486,53	407,68	283,43	221,06	200,36	211,61	241,78	321,07	407,87	387,46
60°	331,35	463,58	492,63	395,37	264,01	200,40	181,31	192,30	222,49	304,94	407,92	391,99
62°	327,54	466,69	499,05	377,34	241,41	178,36	158,87	170,51	201,70	287,91	410,58	397,87
64°	314,63	455,89	504,61	353,12	216,10	152,01	131,99	145,39	178,72	266,70	416,95	396,33
66°	308,18	438,45	493,81	324,51	187,55	120,21	103,75	116,95	153,66	241,51	412,85	390,38
68°	302,03	429,95	463,73	289,86	152,77	88,09	76,40	89,13	123,98	214,94	387,18	401,44
70°	284,31	417,18	432,06	239,41	109,52	63,77	56,42	66,99	92,40	178,96	370,52	410,99
72°	236,40	378,80	394,33	186,11	79,49	49,61	44,80	51,40	70,11	135,65	351,13	390,91
74°	163,90	299,59	334,99	138,47	61,96	39,67	36,19	40,64	56,74	97,11	303,71	330,75
76°	79,90	193,05	251,62	99,40	49,92	31,42	27,76	32,16	46,60	68,05	223,85	235,28
78°	26,99	78,69	162,49	63,32	39,83	24,30	21,99	24,86	36,38	46,97	146,84	105,32
80°	12,62	33,43	76,07	37,21	31,12	18,27	16,67	18,81	27,28	31,97	71,63	38,72
82°	7,15	16,77	28,02	22,80	22,07	12,51	11,98	13,11	19,37	22,63	25,15	16,40
84°	4,21	7,53	11,59	11,29	12,97	7,44	8,01	8,09	11,21	11,07	9,53	7,04
86°	2,60	2,77	4,21	4,40	5,87	3,58	4,39	4,26	5,43	3,83	3,25	1,94
88°	1,58	1,38	2,36	2,02	2,13	2,19	2,95	2,64	2,71	1,80	1,76	1,13
90°	0,67	1,06	1,81	2,15	1,93	1,70	2,17	2,40	1,93	1,26	0,83	0,95

γ \ C	180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°
0°	229,31	229,31	229,31	229,31	229,31	229,31	229,31	229,31	229,31	229,31	229,31	229,31
2°	228,70	225,93	223,65	221,73	220,70	216,07	218,60	219,41	221,03	222,61	225,26	227,27
4°	228,01	222,90	217,78	213,74	210,50	204,58	207,64	209,36	211,18	215,63	220,57	225,47
6°	227,52	220,03	211,54	204,83	199,74	193,46	195,54	197,41	201,30	207,48	215,60	223,77
8°	227,95	217,04	205,57	196,34	188,64	182,20	183,57	185,65	190,86	199,16	210,73	222,61
10°	227,12	213,92	199,08	187,88	178,09	169,45	170,20	172,97	179,52	190,70	203,99	219,92
12°	227,13	210,46	192,65	179,16	166,06	156,76	156,98	160,98	168,05	181,49	198,33	217,74
14°	227,53	206,85	186,97	169,27	154,90	146,33	146,38	147,54	156,00	172,24	192,48	215,24
16°	226,45	204,01	180,61	159,97	146,13	138,33	138,92	139,84	144,82	161,66	186,22	212,49
18°	226,16	200,25	173,63	151,19	139,08	132,96	134,17	133,94	137,49	152,00	179,33	209,62
20°	226,27	196,82	167,12	143,09	134,13	129,61	131,05	130,09	131,87	141,87	172,44	207,36
22°	226,96	193,39	159,54	136,56	130,21	125,60	124,68	125,20	127,49	133,55	164,30	204,55
24°	227,50	189,97	152,51	130,30	126,02	117,38	117,93	117,28	122,73	126,70	156,51	201,37
26°	228,48	186,20	145,23	126,27	117,66	113,03	114,09	112,77	114,52	121,23	147,89	199,11
28°	229,20	182,99	137,91	121,08	113,74	109,14	110,62	109,57	108,31	115,40	139,66	196,35
30°	230,58	179,71	129,23	113,92	108,93	106,36	107,21	105,27	103,54	108,41	130,50	194,29
32°	233,39	176,12	124,32	105,47	104,39	102,38	102,56	101,01	99,48	99,82	122,97	191,98
34°	234,82	172,78	115,43	100,48	99,84	96,97	96,61	95,87	93,89	94,10	115,02	190,01
36°	237,17	169,37	108,43	94,41	94,52	91,97	92,04	90,50	89,10	87,73	107,93	188,53
38°	239,44	166,47	101,05	88,04	89,00	86,32	86,34	85,36	83,29	82,04	101,35	187,23
40°	242,61	163,26	91,50	82,27	83,16	82,45	82,41	80,78	77,60	76,81	93,61	184,72
42°	245,60	159,41	85,22	76,96	77,96	78,24	78,18	77,21	72,57	71,73	85,87	182,73
44°	249,95	156,57	80,21	71,32	73,78	74,13	74,10	73,29	68,03	67,48	79,85	180,00
46°	253,19	153,53	74,20	65,68	69,65	70,42	70,18	69,51	64,09	62,62	74,62	177,97
48°	258,02	149,00	69,03	61,14	65,14	66,38	66,05	65,85	60,00	58,28	70,08	175,95
50°	261,44	144,99	64,65	57,12	61,08	63,40	63,96	61,49	56,44	54,75	65,33	173,35
52°	265,29	140,72	59,45	53,34	56,54	62,87	75,34	61,40	51,69	51,57	61,40	172,05
54°	268,43	135,83	55,28	49,31	52,03	82,59	110,46	79,27	47,78	48,28	57,17	171,06
56°	270,60	130,12	51,06	45,60	52,31	104,18	128,20	101,65	46,64	45,47	53,23	169,69
58°	271,55	122,04	46,45	42,18	57,64	114,03	138,15	112,67	50,01	41,95	49,37	167,20
60°	270,32	113,64	43,03	38,83	60,34	121,82	128,78	121,74	52,60	39,03	45,93	160,07
62°	264,04	105,37	38,91	35,44	62,22	115,22	108,93	115,82	54,09	35,41	42,47	150,43
64°	254,09	96,71	34,83	32,30	63,60	94,36	73,81	95,81	55,29	32,56	38,38	140,41
66°	254,23	91,55	31,15	30,19	63,04	63,78	50,70	63,37	55,28	30,17	35,15	138,06
68°	260,21	89,71	27,97	27,76	53,04	40,91	33,91	40,96	46,17	27,05	31,76	136,38
70°	251,58	86,77	25,04	24,39	40,73	27,01	21,31	27,09	36,10	24,60	27,73	125,97
72°	207,91	72,33	21,22	20,80	27,96	15,11	10,42	16,00	25,78	21,32	23,70	99,08
74°	145,51	46,62	17,87	16,86	18,00	6,65	2,02	6,66	15,96	16,49	19,78	62,74
76°	63,23	23,11	14,54	13,08	8,45	2,85	1,37	2,99	8,62	12,88	15,93	28,66
78°	21,34	17,25	10,44	8,60	5,29	1,79	1,50	2,38	4,89	9,46	11,20	14,24
80°	10,66	7,04	6,91	5,43	3,00	1,78	1,60	1,83	2,95	5,30	7,69	7,89
82°	5,37	3,76	3,79	3,12	1,71	1,19	2,15	1,98	1,85	2,78	4,35	4,68
84°	3,01	2,63	2,27	1,74	1,42	1,63	0,89	1,21	1,16	1,62	1,99	2,45
86°	1,87	1,13	1,48	1,64	0,91	0,76	1,30	0,99	1,21	1,52	1,08	1,47
88°	1,32	0,99	1,45	1,17	1,43	1,04	0,68	1,36	0,65	1,20	0,87	1,83
90°	1,30	1,12	1,33	1,32	1,03	1,44	1,24	0,93	1,14	0,96	1,07	0,98

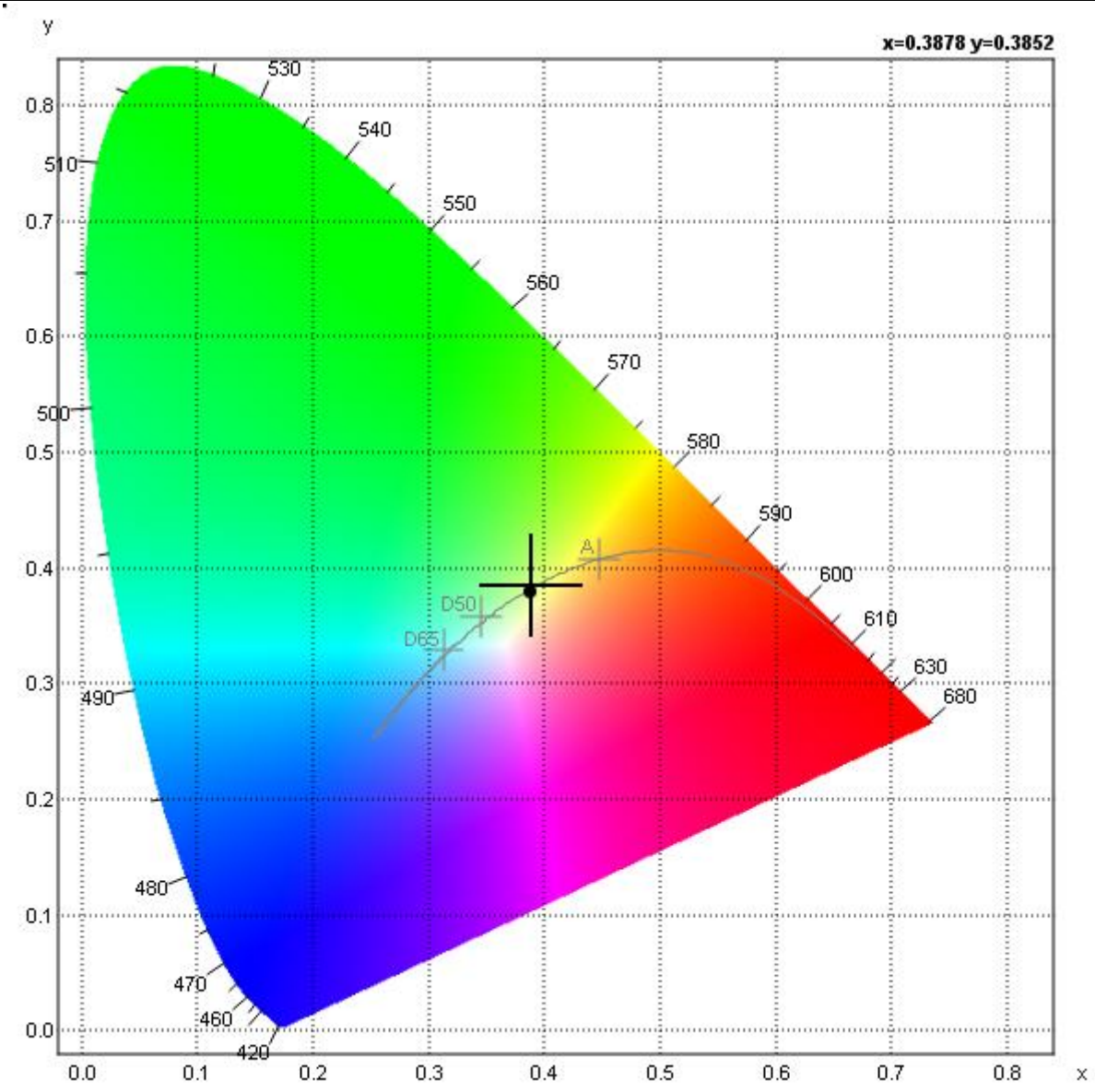
10. BEAM CONE



11. BEAM ANGLES

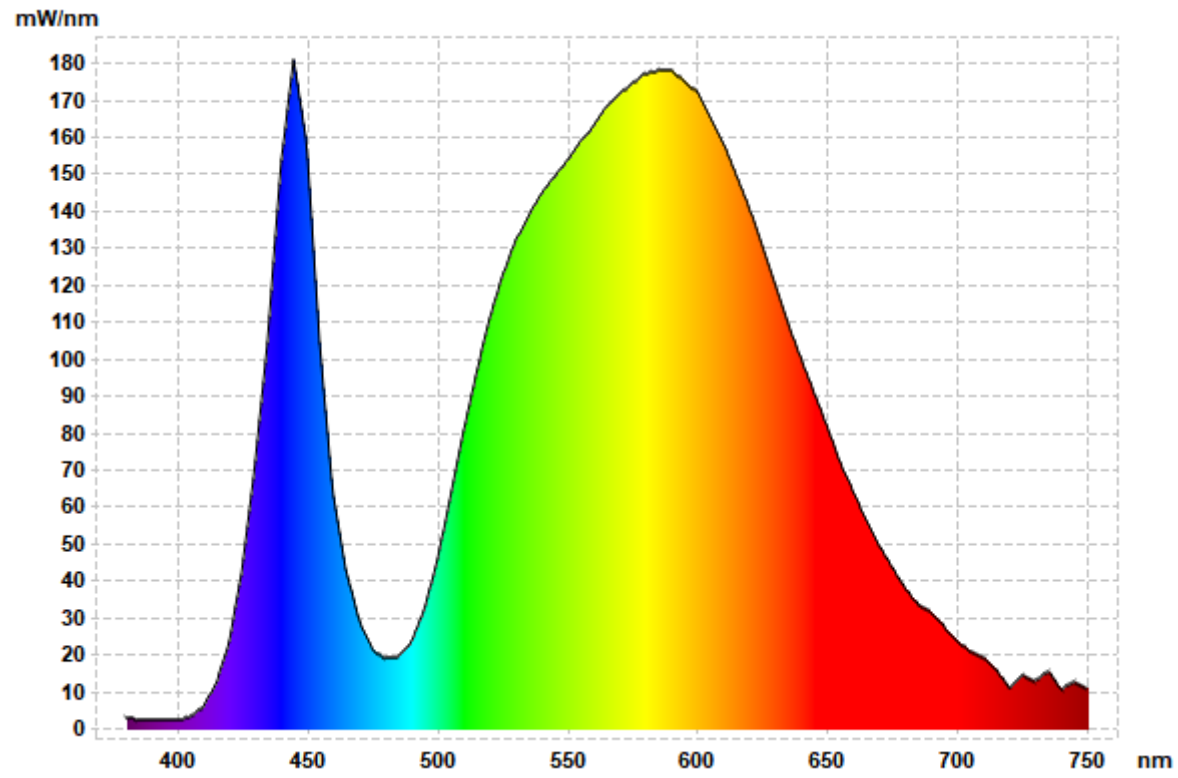
C plane	Beam angle [°]	Gamma max [°]	Start [°]	Stop [°]
0-180	147,3	60,0	-73,4	74,0
15-195	0,0	62,0	0,0	0,0
30-210	0,0	64,0	0,0	0,0
45-225	71,6	44,0	-1,0	70,5
60-240	68,1	36,0	-3,8	64,3
75-255	63,7	32,0	-4,0	59,6
90-270	61,4	30,0	-4,2	57,2
105-285	64,5	30,0	-5,4	59,1
120-300	69,4	34,0	-6,9	62,5
135-315	76,6	44,0	-7,7	68,8
150-330	85,1	64,0	-8,7	76,4
165-345	97,8	70,0	-21,3	76,5

12. COLOURIMETRIC PARAMETERS



CIE 1931 2° OBSERVER		OTHER	
x:	0,3878	CCT:	**3869 K**
y:	0,3852	Chromaticity Error:	0,006
u':	0,2266	Colour Peak:	445,94 nm
v':	0,5063	Colour Dominant:	578,7 nm
L:	100,00	Purity:	N/A
a:	9,72		
b:	37,01		
X:	10158,27		
Y:	10088,00		
Z:	5945,51		

13. SPECTRUM AND COLOUR RENEDING INDEX



COLOUR RENDERING INDEXES

Ra	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
71,6	69,4	77,0	82,9	72,1	68,6	67,6	80,5	54,5	-24,4	45,3	68,1	41,5	70,0	90,0	62,7

14. EQUIPMENT USED

NO.	EQUIPMENT	PRODUCER/TYPE	SERIES	MARK	USED
1.	Goniometer C-γ	GL Optic / GLG-20-1500	G1500-019 4/2017	LAB/UP/26	☒
2.	AC power supply	ITECH / IT7322	602130010727750003	LAB/UP/39	☒
3.	DC power supply	ITECH / IT6724H	600469010727730003	LAB/UP/40	☐
4.	Power meter	ITECH / IT9121	60217300001045	LAB/PP/11	☒
5.	Spectrometer	GL Optic / SPECTIS 1.0 VIS GLX10	X0010261/B14W0060	LAB/PP/30	☒
6.	Spectrometer	GL Optic / SPECTIS 1.0 FLICKER VIS	Xt010065/16J00129	LAB/PP/29	☐
7.	Spectrometer	GL Optic / SPECTIS 5.0 UV-VIS-NIR	Xt050149/1104N069	LAB/PP/31	☐
8.	Luminance telescope	GL OPTIC / GL PSM	GL 160324	LAB/UP/27	☐
9.	Thermo-hygrometer	T&D / TR-72wf	4214 09BA	LAB/UP/37	☒

Proiectant::
Michał Wierzykowski , Lighting designer / Export Dept.

Lug Light Factory Ltd.
65-127 Zielona Góra, ul. Gorzowska 11, POLAND

+48 68 411 72 58 fax: +48 68 45 33 201
Michal.Wierzykowski@lug.com.pl

Data:
18.02.2019

Simulare Risipeni

Risipeni, Falesti

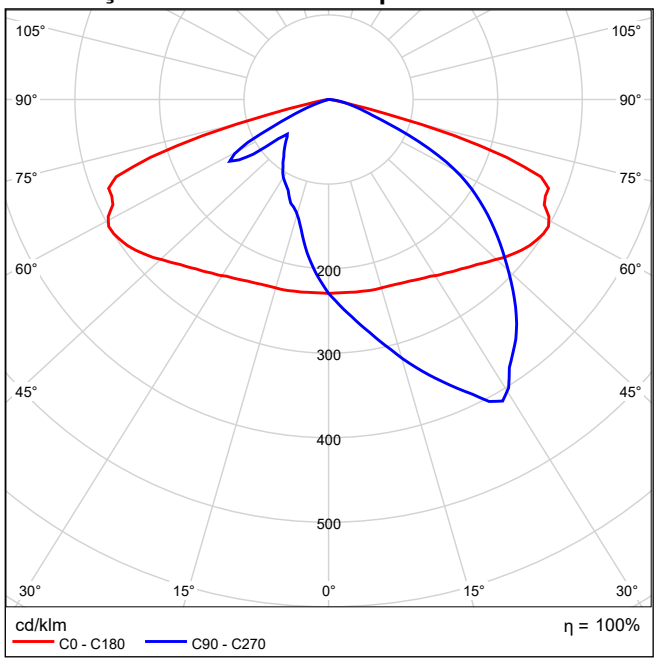
Cuprins

LUG LIGHT FACTORY 130252.6L112.011 5264_10 URBINO PREMIUM 72 LED 740 II O13 1xLED

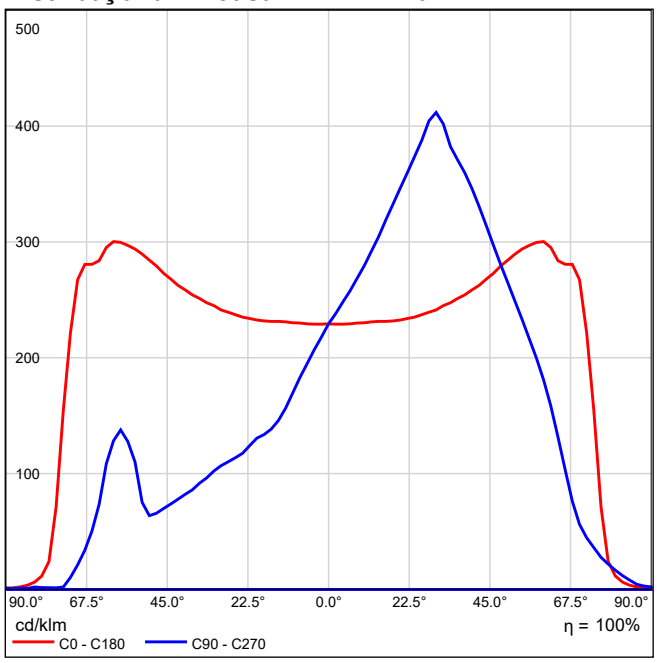
Vedeţi catalogul nostru de corpuri de iluminat pentru o imagine a corpului de iluminat.

Randament luminos: 100.02%
Flux luminos corpuri de iluminat: 10052 lm
Putere: 76.0 W
Eficienţa luminoasă: 132.3 lm/W

Distribuţia luminoasă 1 / LVK polar

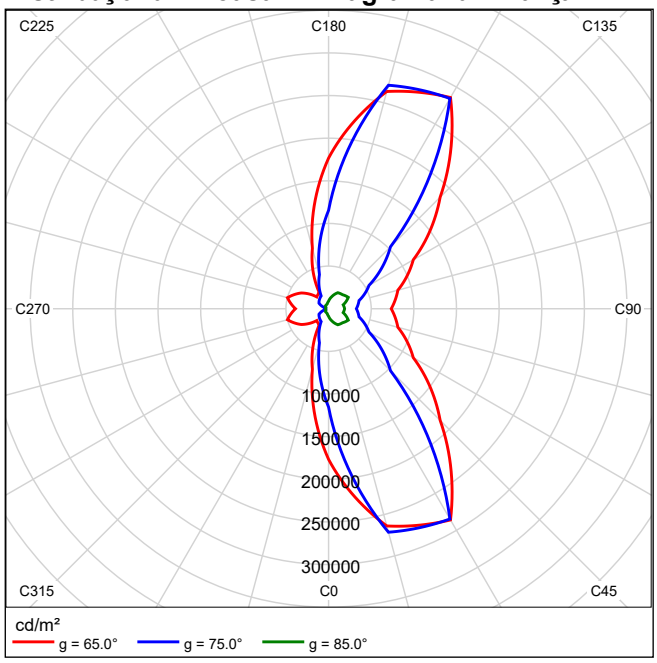


Distribuţia luminoasă 1 / LVK liniar



O diagramă conică nu poate fi generată deoarece dispersia luminii este asimetrică.

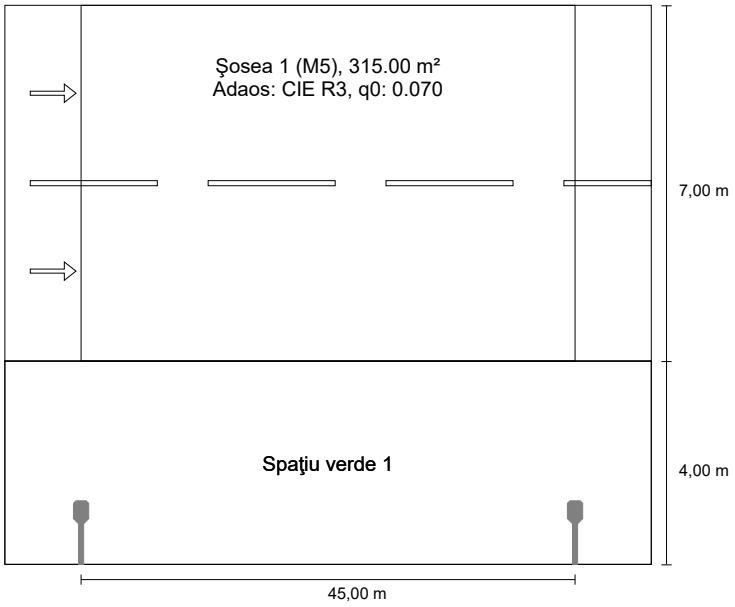
Distribuţia luminoasă 1 / Diagrama luminanţă

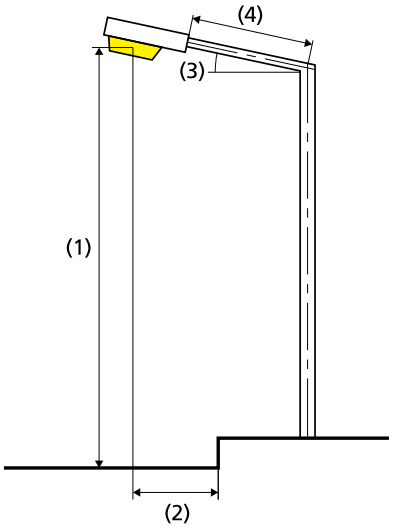


O diagramă UGR nu poate fi generată deoarece dispersia luminii este asimetrică.

Stradă 1 până la EN 13201:2015

LUG LIGHT FACTORY 130252.6L112.011 5264_10 URBINO PREMIUM 72 LED 740 II O13





Lampă:	1xLED
Flux luminos (corp de iluminat):	10051.59 lm
Flux luminos (lampă):	10050.00 lm
Ore de lucru	
4000 h:	100.0 %, 76.0 W
W/km:	1672.0
Aranjament:	Pe o parte Jos
Distanţă stâlp:	45.000 m
Înclinare consolă (3):	0.0°
Lungime consolă (4):	1.000 m
Înălţimea deasupra planului util (1):	9.000 m
Ieşirea în consolă a punctului de lumină (2):	-3.000 m

Rezultate pentru câmpurile de evaluare

Factorul de menţinere: 0.85

Şosea 1 (M5)

Lm [cd/m²] ≥ 0.50	Uo ≥ 0.35	Ul ≥ 0.40	TI [%] ≤ 15	EIR ≥ 0.30
✔ 0.52	✔ 0.47	✔ 0.49	✔ 12	✔ 0.54

Rezultate pentru indicatorii de eficienţă energetică

Indicatorul densităţii de putere (Dp)	0.023 W/lxm²
Densitatea consumului de energie	
Aranjament: 5264_10 URBINO PREMIUM 72 LED 740 II O13 (304.0 kWh/an)	1.0 kWh/m² an

ULR:	0.00
ULOR:	0.00
Valori maxime ale intensităţii luminoase	
La 70°:	415 cd/klm
La 80°:	73.9 cd/klm
La 90°:	2.20 cd/klm
Clasă intensitate luminoasă:	G*4

Orice direcţie ce formează unghiul dat cu verticala în jos a corpurilor de iluminat instalate pentru utilizare.

Aranjamentul respectă clasa cu indici de orbire D.4

Şosea 1 (M5)

Factorul de menţinere: 0.85
Raster: 15 x 6 Puncte

Lm [cd/m²] ≥ 0.50	Uo ≥ 0.35	Ul ≥ 0.40	TI [%] ≤ 15	EIR ≥ 0.30
✔ 0.52	✔ 0.47	✔ 0.49	✔ 12	✔ 0.54

Observatori ataşaţi (2):

Observator	Poziţie [m]	Lm [cd/m²] ≥ 0.50	Uo ≥ 0.35	Ul ≥ 0.40	TI [%] ≤ 15
Observator 1	(-60.000, 5.750, 1.500)	0.52	0.48	0.49	12
Observator 2	(-60.000, 9.250, 1.500)	0.57	0.47	0.72	7

Şosea 1 (M5)

Iluminare orizontală [lx]

10.417	10.4	9.68	8.23	6.65	5.39	4.64	3.82	**3.59**	3.82	4.64	5.39	6.65	8.23	9.68	10.4
9.250	14.0	12.7	10.4	7.85	6.20	4.93	4.04	3.79	4.04	4.93	6.20	7.85	10.4	12.7	14.0
8.083	18.4	16.3	12.6	9.10	6.74	5.14	4.23	3.97	4.23	5.14	6.74	9.10	12.6	16.3	18.4
6.917	23.6	19.8	14.7	10.3	7.07	5.29	4.30	4.10	4.30	5.29	7.07	10.3	14.7	19.8	23.6
5.750	28.2	22.6	16.4	10.8	7.33	5.42	4.25	3.96	4.25	5.42	7.33	10.8	16.4	22.6	28.2
4.583	**29.3**	23.6	16.9	11.2	7.49	5.27	4.07	3.78	4.07	5.27	7.49	11.2	16.9	23.6	**29.3**
m	**1.500**	**4.500**	**7.500**	**10.500**	**13.500**	**16.500**	**19.500**	**22.500**	**25.500**	**28.500**	**31.500**	**34.500**	**37.500**	**40.500**	**43.500**

Raster: 15 x 6 Puncte

Em [lx]	Emin [lx]	Emax [lx]	g1	g2
10.5	3.59	29.3	0.343	0.123

Observator 1

Densitate a luminii cu carosabil uscat [cd/m²]

10.417	0.31	0.30	0.30	0.28	**0.25**	0.26	**0.25**	0.28	0.30	0.34	0.34	0.32	0.34	0.32	0.32
9.250	0.42	0.38	0.36	0.32	0.29	0.29	0.29	0.32	0.35	0.39	0.41	0.40	0.42	0.43	0.43
8.083	0.55	0.49	0.42	0.37	0.33	0.32	0.34	0.37	0.41	0.45	0.50	0.53	0.54	0.57	0.57
6.917	0.70	0.60	0.48	0.42	0.38	0.38	0.40	0.44	0.49	0.53	0.62	0.68	0.71	0.75	0.74
5.750	0.82	0.69	0.54	0.46	0.44	0.45	0.48	0.54	0.61	0.70	0.78	0.82	0.90	0.90	0.90
4.583	0.85	0.72	0.57	0.51	0.52	0.56	0.63	0.70	0.75	0.88	0.99	1.01	**1.06**	1.02	0.94
m	**1.500**	**4.500**	**7.500**	**10.500**	**13.500**	**16.500**	**19.500**	**22.500**	**25.500**	**28.500**	**31.500**	**34.500**	**37.500**	**40.500**	**43.500**

Raster: 15 x 6 Puncte

Lm [cd/m²]	Lmin [cd/m²]	Lmax [cd/m²]	g1	g2
0.52	0.25	1.06	0.485	0.239

Densitate a luminii cu lampă nouă [cd/m²]

10.417	0.37	0.36	0.35	0.33	**0.30**	0.31	**0.30**	0.32	0.35	0.40	0.40	0.38	0.40	0.38	0.37
9.250	0.49	0.45	0.42	0.38	0.35	0.34	0.34	0.37	0.41	0.46	0.49	0.47	0.50	0.50	0.50
8.083	0.65	0.58	0.50	0.43	0.39	0.38	0.40	0.44	0.48	0.52	0.59	0.62	0.64	0.68	0.67
6.917	0.82	0.71	0.56	0.49	0.44	0.44	0.47	0.52	0.58	0.63	0.72	0.80	0.83	0.88	0.87
5.750	0.97	0.81	0.63	0.55	0.52	0.53	0.56	0.63	0.72	0.82	0.91	0.97	1.06	1.06	1.05
4.583	1.00	0.85	0.68	0.60	0.61	0.66	0.75	0.82	0.88	1.04	1.17	1.18	**1.24**	1.20	1.10
m	**1.500**	**4.500**	**7.500**	**10.500**	**13.500**	**16.500**	**19.500**	**22.500**	**25.500**	**28.500**	**31.500**	**34.500**	**37.500**	**40.500**	**43.500**

Raster: 15 x 6 Puncte

Lm [cd/m²]	Lmin [cd/m²]	Lmax [cd/m²]	g1	g2
0.61	0.30	1.24	0.485	0.239

Observator 2

Densitate a luminii cu carosabil uscat [cd/m²]

10.417	0.31	0.31	0.30	0.29	**0.27**	**0.27**	**0.27**	0.29	0.32	0.36	0.35	0.34	0.34	0.33	0.32
9.250	0.42	0.39	0.36	0.34	0.31	0.31	0.31	0.34	0.38	0.42	0.44	0.43	0.44	0.44	0.43
8.083	0.56	0.51	0.44	0.39	0.37	0.37	0.38	0.41	0.45	0.49	0.54	0.56	0.57	0.59	0.58
6.917	0.71	0.63	0.51	0.47	0.44	0.43	0.47	0.52	0.55	0.61	0.67	0.73	0.75	0.77	0.75
5.750	0.85	0.72	0.58	0.52	0.53	0.57	0.62	0.64	0.71	0.80	0.86	0.89	0.95	0.92	0.91
4.583	0.88	0.76	0.64	0.62	0.65	0.71	0.79	0.87	0.93	1.01	**1.10**	1.08	**1.10**	1.06	0.96
m	**1.500**	**4.500**	**7.500**	**10.500**	**13.500**	**16.500**	**19.500**	**22.500**	**25.500**	**28.500**	**31.500**	**34.500**	**37.500**	**40.500**	**43.500**

Raster: 15 x 6 Puncte

Lm [cd/m²]	Lmin [cd/m²]	Lmax [cd/m²]	g1	g2
0.57	0.27	1.10	0.471	0.242

Densitate a luminii cu lampă nouă [cd/m²]

10.417	0.37	0.36	0.35	0.34	0.32	0.32	**0.31**	0.35	0.38	0.42	0.42	0.40	0.41	0.39	0.37
9.250	0.49	0.46	0.43	0.40	0.37	0.37	0.37	0.40	0.45	0.49	0.51	0.50	0.51	0.51	0.51
8.083	0.66	0.59	0.52	0.46	0.43	0.43	0.45	0.49	0.53	0.57	0.63	0.66	0.68	0.70	0.68
6.917	0.84	0.74	0.60	0.55	0.51	0.51	0.55	0.61	0.65	0.71	0.79	0.86	0.88	0.90	0.89
5.750	1.00	0.85	0.69	0.61	0.62	0.67	0.72	0.75	0.83	0.94	1.02	1.05	1.12	1.09	1.08
4.583	1.03	0.90	0.76	0.73	0.77	0.84	0.93	1.02	1.09	1.19	**1.29**	1.27	**1.29**	1.24	1.12
m	**1.500**	**4.500**	**7.500**	**10.500**	**13.500**	**16.500**	**19.500**	**22.500**	**25.500**	**28.500**	**31.500**	**34.500**	**37.500**	**40.500**	**43.500**

Raster: 15 x 6 Puncte

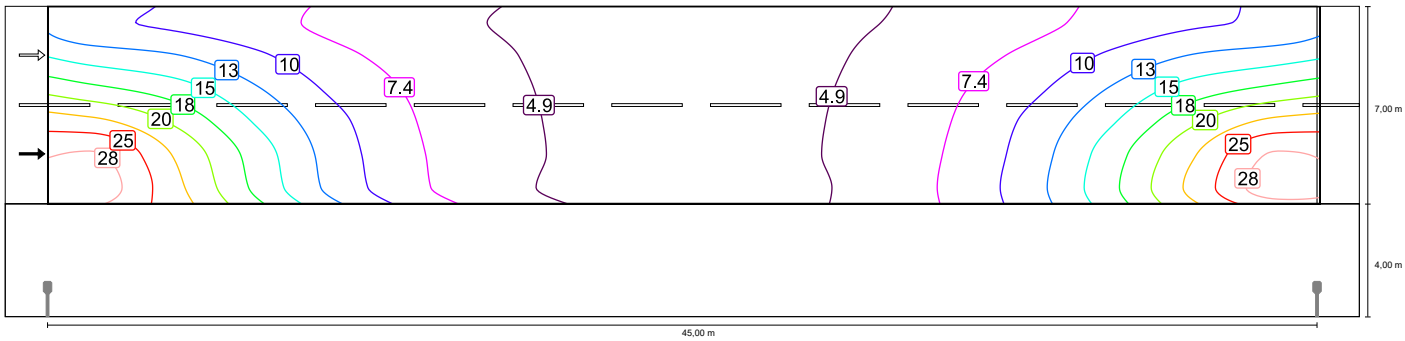
Lm [cd/m²]	Lmin [cd/m²]	Lmax [cd/m²]	g1	g2
0.66	0.31	1.29	0.471	0.242

Şosea 1 (M5)

Factorul de menţinere: 0.85
Raster: 15 x 6 Puncte

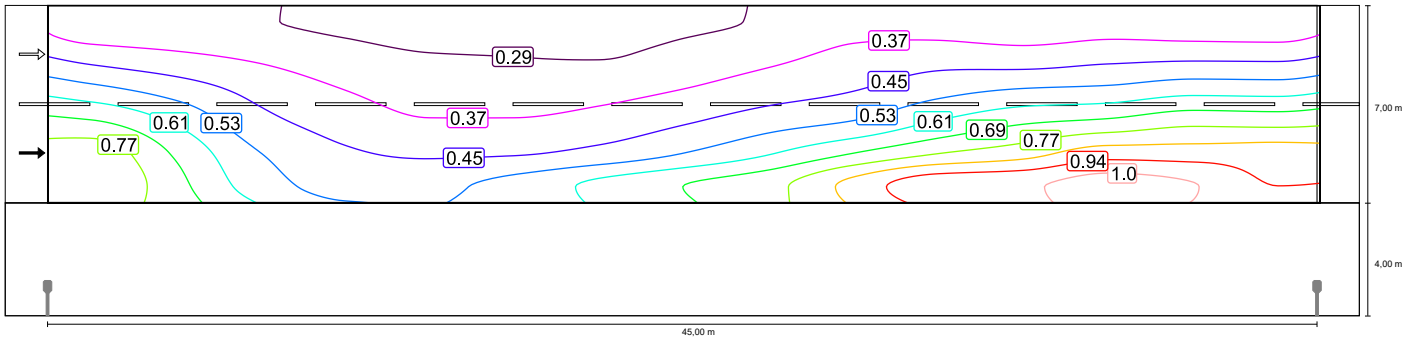
Lm [cd/m²] ≥ 0.50	Uo ≥ 0.35	Ul ≥ 0.40	TI [%] ≤ 15	EIR ≥ 0.30
✔ 0.52	✔ 0.47	✔ 0.49	✔ 12	✔ 0.54

Iluminare orizontală

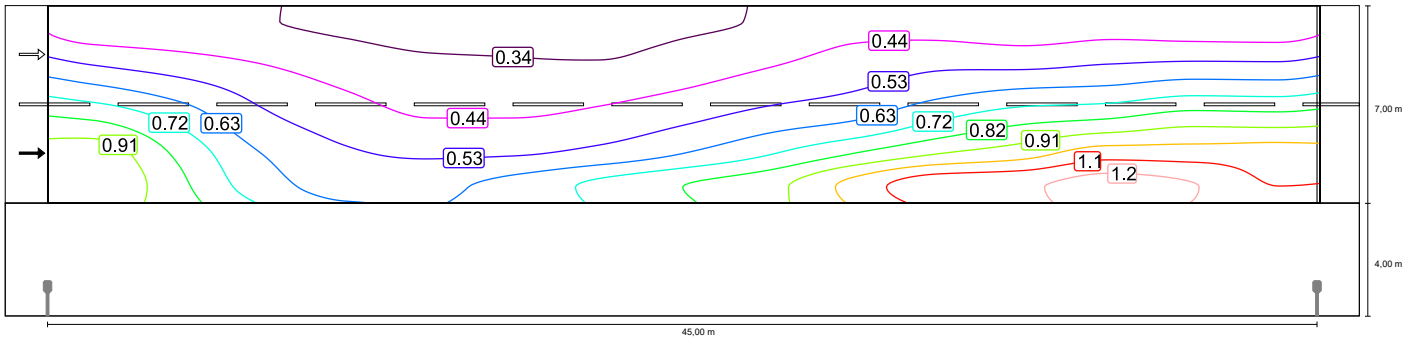


Observator 1

Densitate a luminii cu carosabil uscat

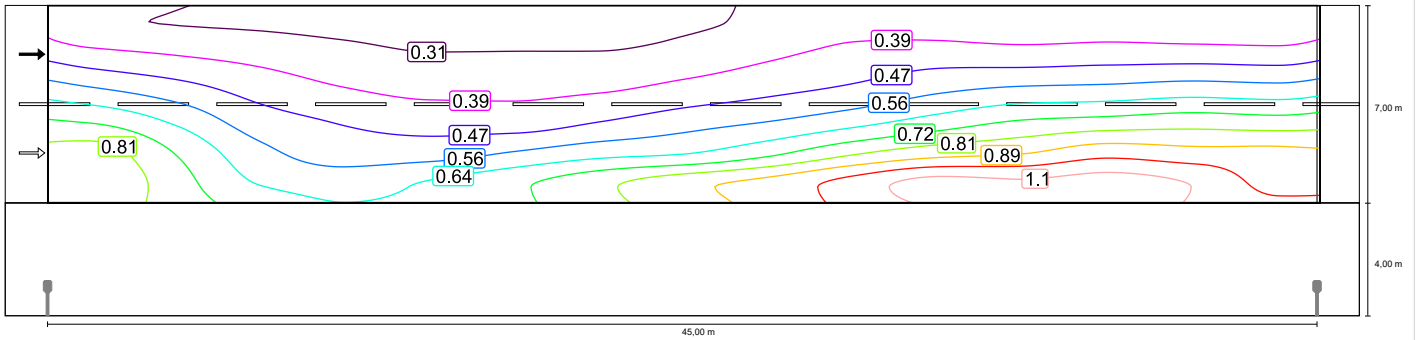


Densitate a luminii cu lampă nouă

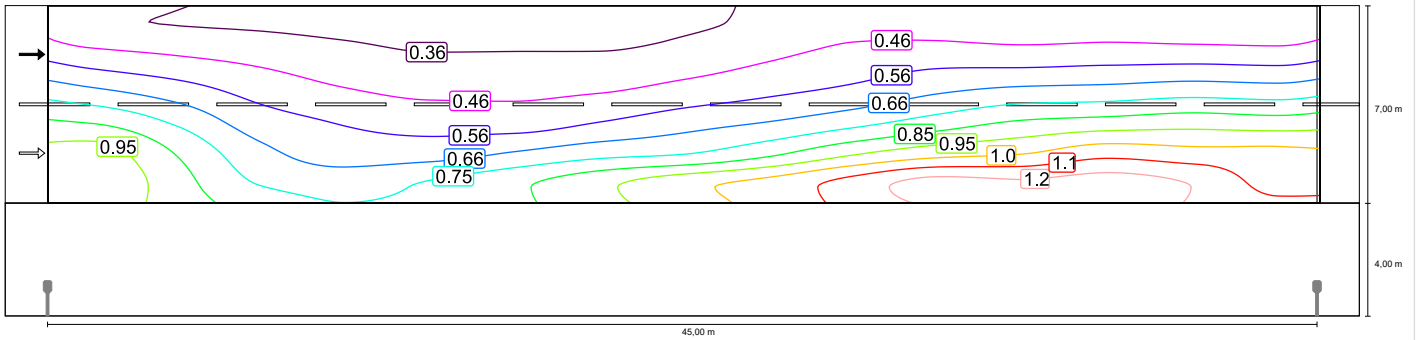


Observator 2

Densitate a luminii cu carosabil uscat



Densitate a luminii cu lampă nouă

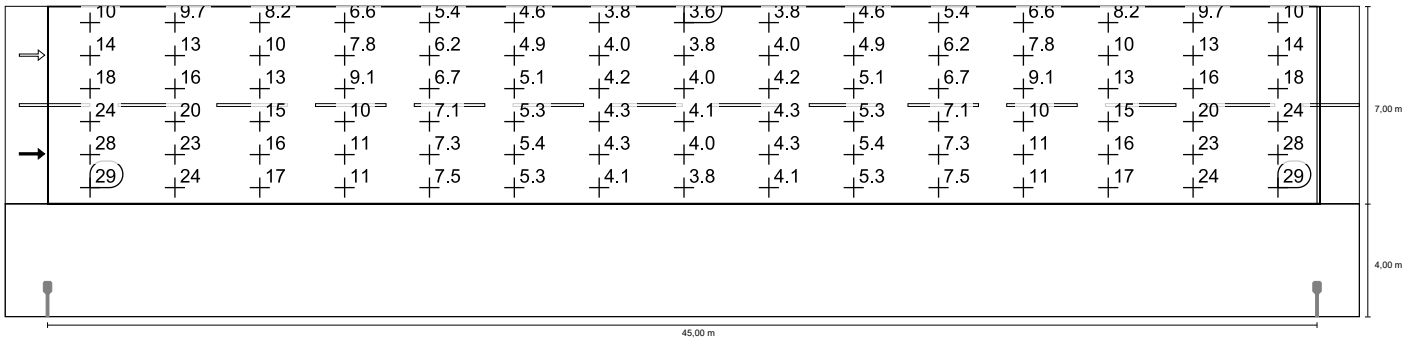


Şosea 1 (M5)

Factorul de menţinere: 0.85
Raster: 15 x 6 Puncte

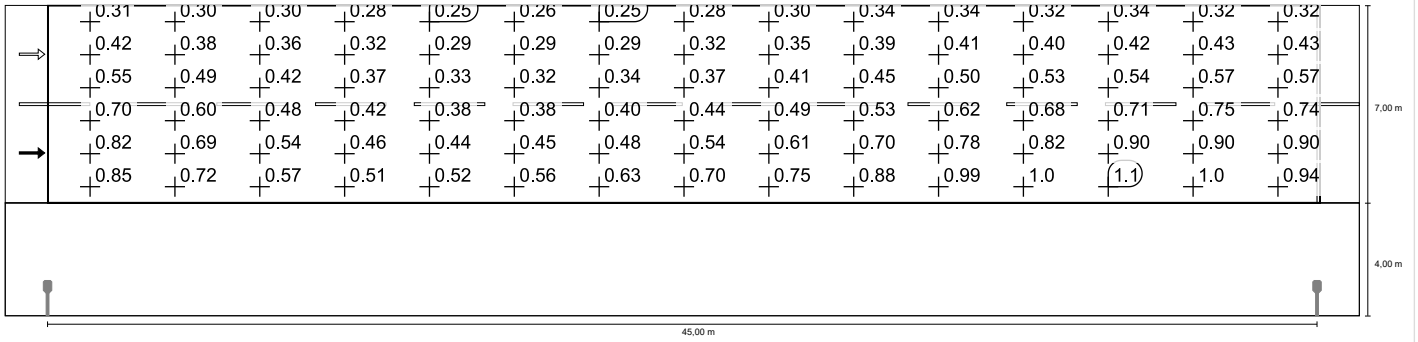
Lm [cd/m²] ≥ 0.50	Uo ≥ 0.35	Ul ≥ 0.40	TI [%] ≤ 15	EIR ≥ 0.30
✔ 0.52	✔ 0.47	✔ 0.49	✔ 12	✔ 0.54

Iluminare orizontală

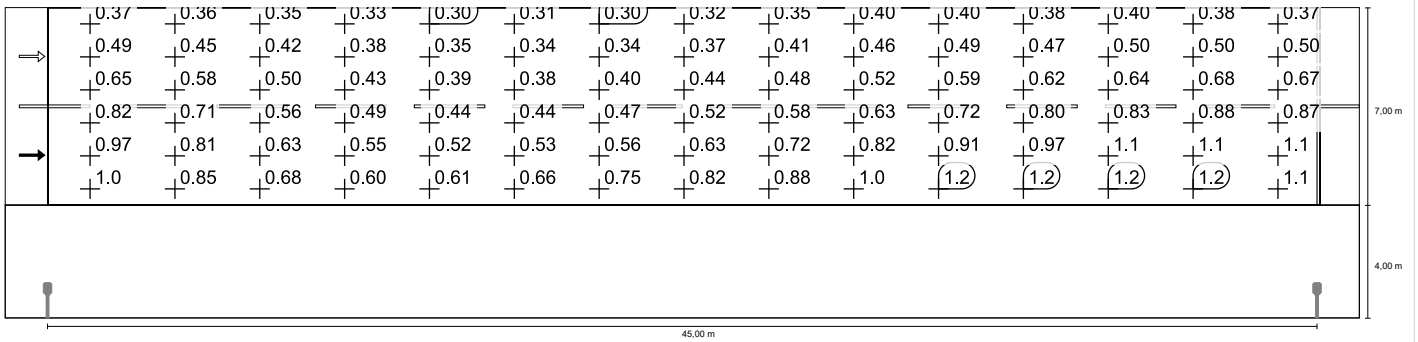


Observator 1

Densitate a luminii cu carosabil uscat

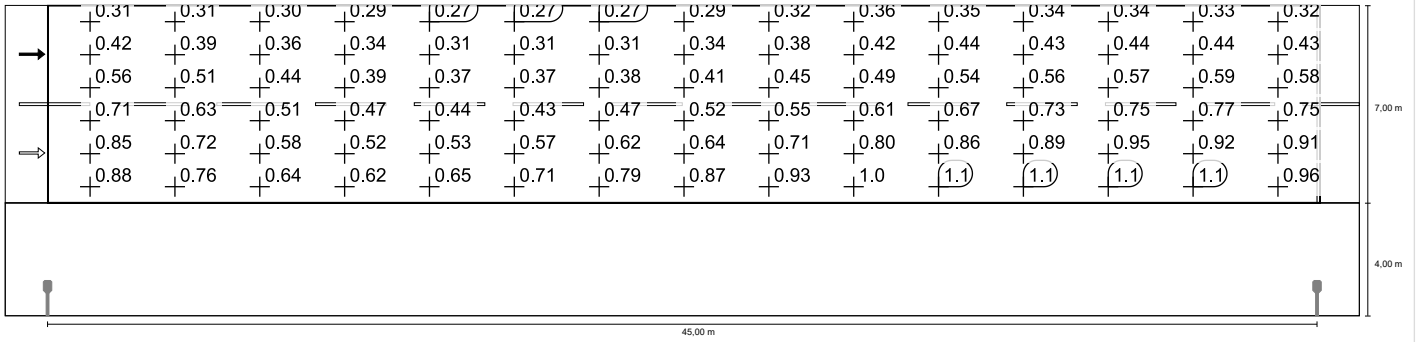


Densitate a luminii cu lampă nouă



Observator 2

Densitate a luminii cu carosabil uscat



Densitate a luminii cu lampă nouă