

# Light Measurement Report

Print date: 28-11-2024

Measurement date and time: 28-11-2024 13:29:28 – Measurement no. VFR-241128-2253-MS

Measurement tracking No. and Link: [VT241128-000039](https://www.viso-systems.com/VT241128-000039)

Operator:



## Laboratory and Equipment

Laboratory Owner and Location  
Goniospectrometer System and Type  
Sensor Name, Calibr. Date and Serial No.  
Spectrometer Manufacturer and Model

Viso Systems, Copenhagen V, Denmark  
LabSpion – Type C, horizontal  
LabSensor Model2 – 11-1-2024 – 3130191315  
Ibsen Photonics, Denmark – Freedom VIS (Custom Viso)

## Measurement Conditions

Number of C-planes and Resolution  
 $\gamma$  (gamma)-Resolution  
Test Distance  
Input Power, Power and Displ. Factors  
Input RMS Voltage and Current  
Frequency of Input Power  
Warm-up Time and Variation

16 planes – 22,5°  
5°  
1,99 m  
3,1 W – PF 0,48 – DPF 0,96  
230 V – 0,028 A  
50 Hz  
Lamp stabilized in 19 min 44 sec – 2,0%

## Tested Light Source

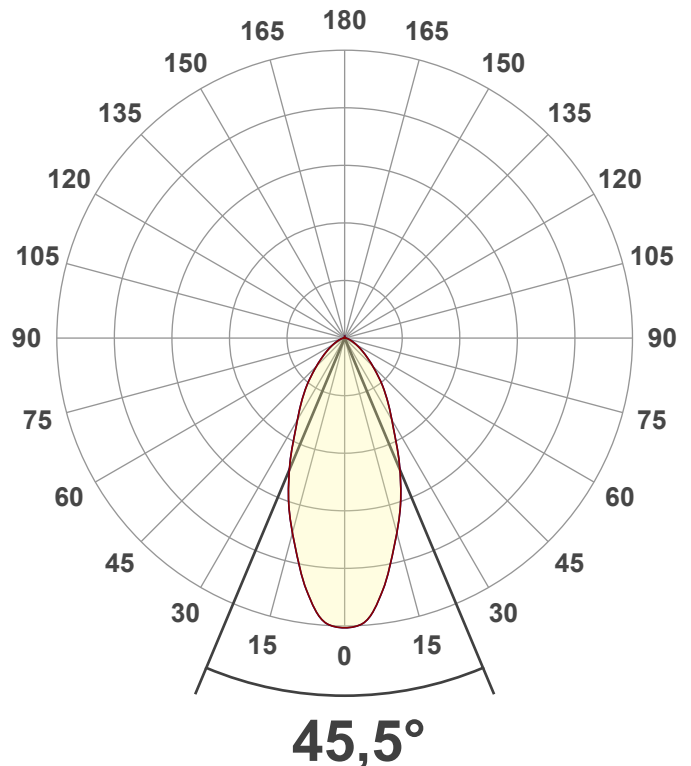
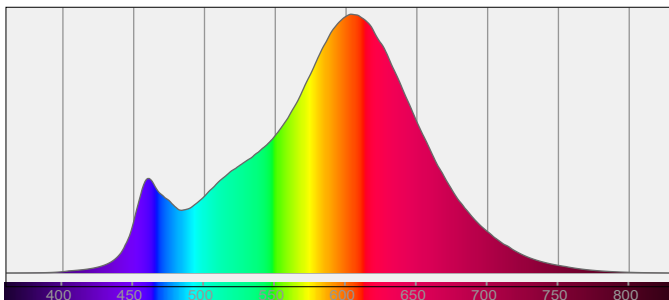
Product Name  
Item No. and Manufacturer  
Product Description (line 1)

276475-2700K  
276475-2700K – Dutchfulfillment  
GU10 MR11 SPOT | 3W

## Main Light Measurement Results

Output – Total Lumen (Up% / Down%)  
Efficiency  
Peak Intensity and Beam Angle  
Correlated Color Temperature, Target/Measured  
Color Rendering Index  
Color Rendering TM30-18  
Color Shift, CIE duv and MacAdam Steps  
Flicker

264 lm – 1,52% / 98,48%  
86 lm/W  
297 cd – 45,5°  
CCT = 2700 K / 2775 K  
CRI 82,2  
 $R_f$  83,3 –  $R_g$  90,1  
Duv 0,0020 – SDCM 3,5  
SVM 0,03 – PstLM 0,01



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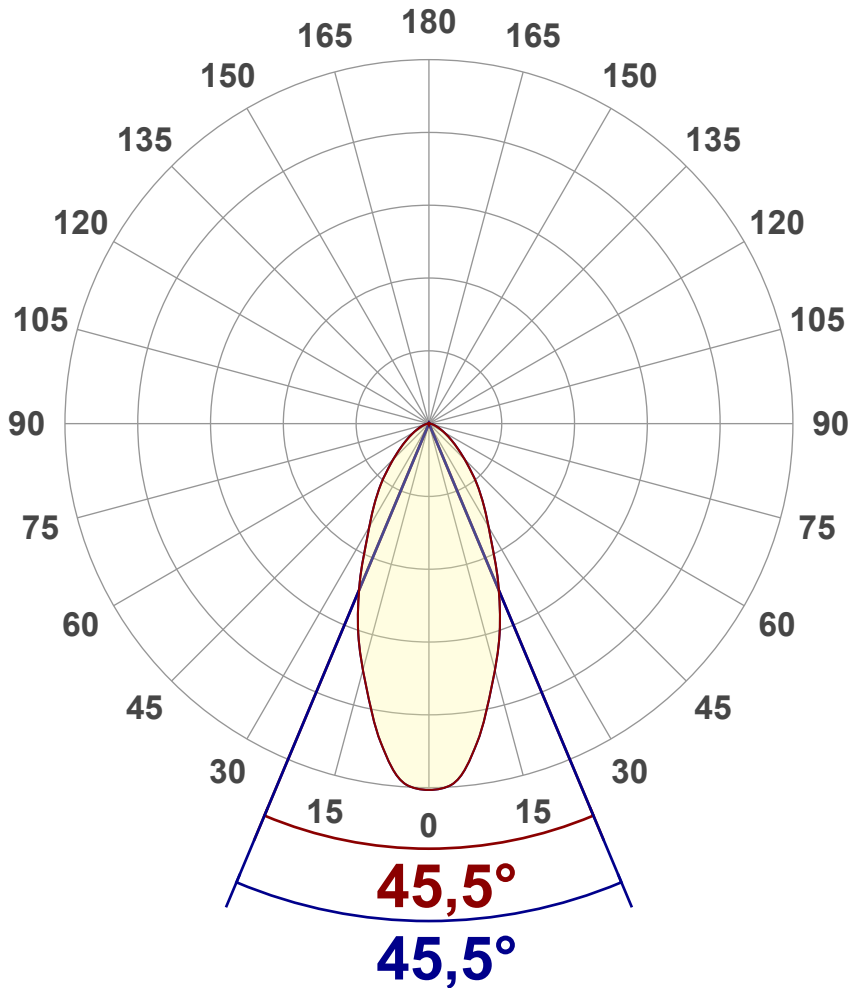
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Operator:



## Luminous Intensity diagram

Unit: 0-100% of peak intensity



### Main Values

Output (total Lumen)	264 lm
Lumen Up% / Down%	1,52% / 98,48%
Peak Intensity	297 cd
Beam Angle (50%)	45,5°
Beam Angle (90%)	45,5°
Beam Angle (10%)	45,5°

### Cut-off Angle

Average 2,5%	136,6°
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### Field Angle

Average 10%	100,1°
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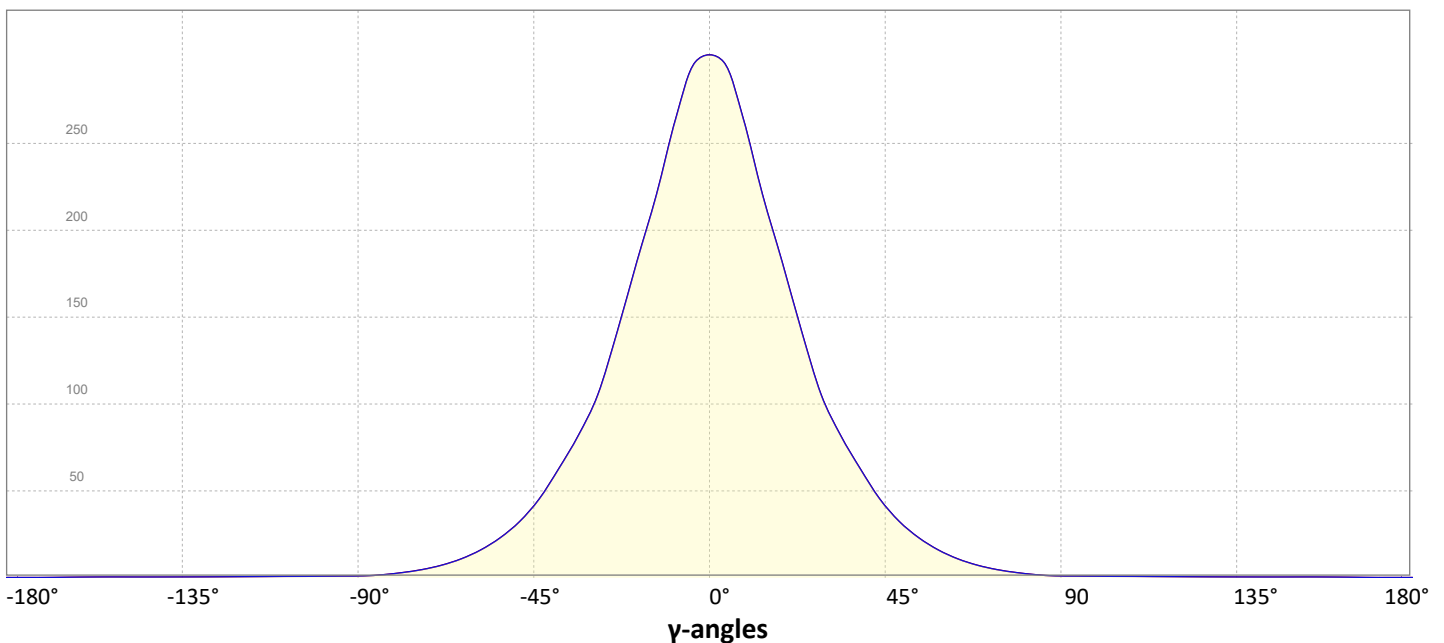
### Intensity Ratio

In 120° cone	92,4%
In 90° cone	79,8%

**C000-C180**

**C090-C270**

## Linear distribution diagram - Intensity (candela) vs $\gamma$ -angle



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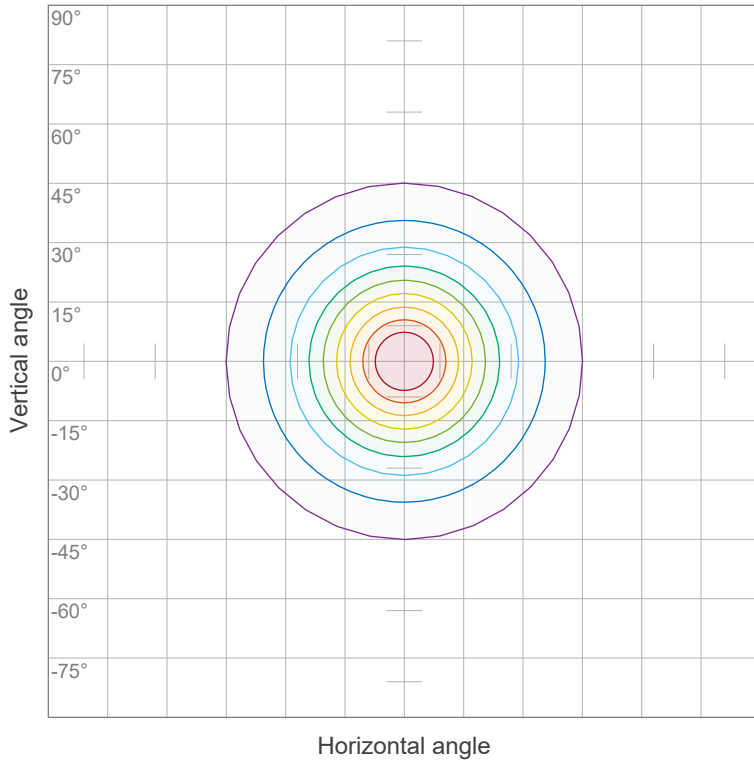
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## Iso-intensity Diagram (Iso-candela)

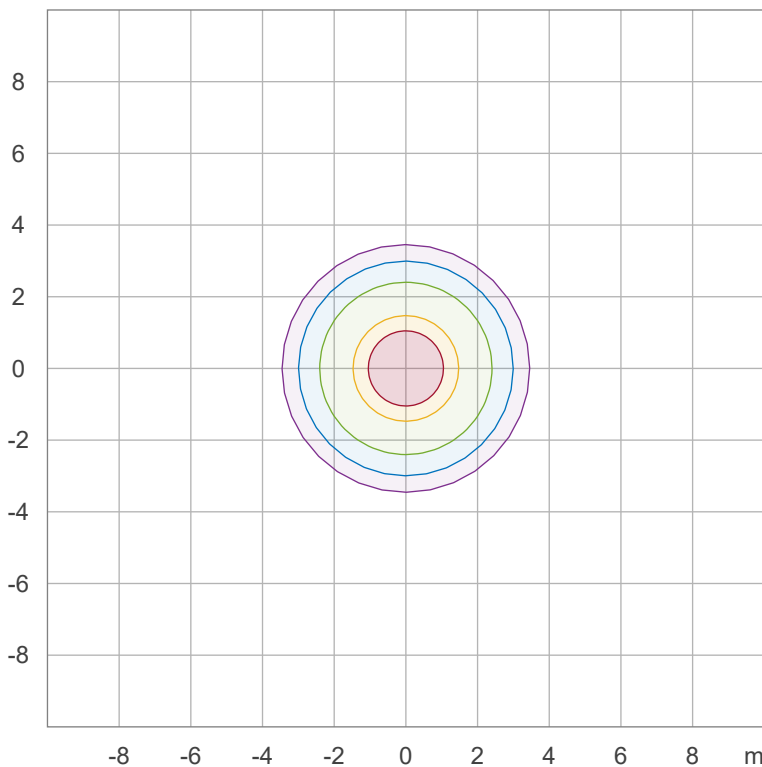


90 %	267,3 cd
80 %	237,6 cd
70 %	207,9 cd
60 %	178,2 cd
50 %	148,5 cd
40 %	118,8 cd
30 %	89,1 cd
20 %	59,4 cd
10 %	29,7 cd

Peak intensity: 297,0 cd

Number of c-planes: 16

## Iso-illuminance Diagram (Iso-lux)



50,0 %	16,5 lx
30,0 %	9,9 lx
10,0 %	3,3 lx
5,0 %	1,6 lx
3,0 %	1,0 lx

Peak illuminance: 33,0 lx

Mounting height: 3,0 m

Number of c-planes: 16

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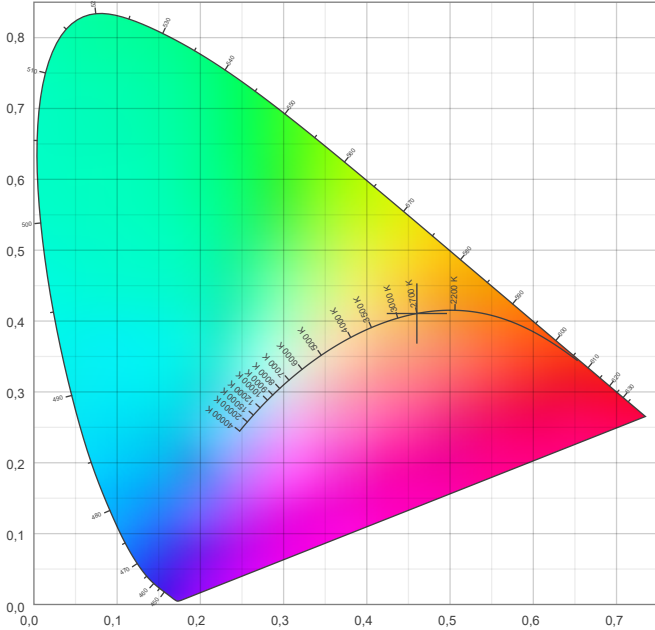


## Color details

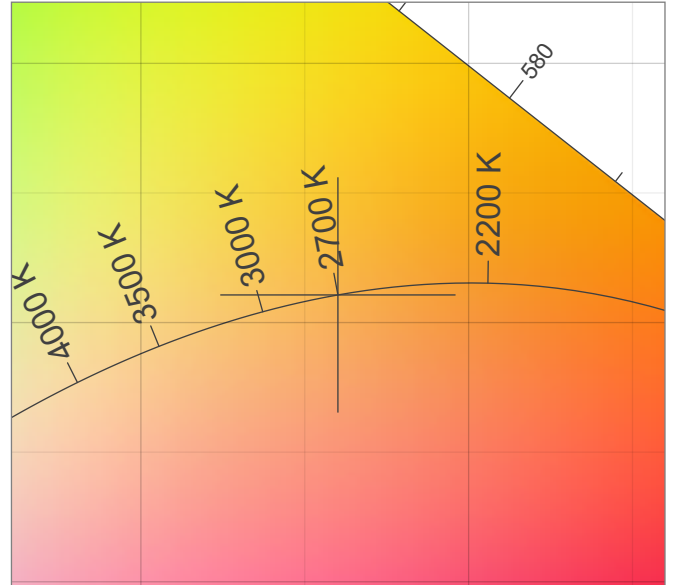
Correlated Color Temperature, Target CCT = 2700 K  
 Correlated Color Temperature, Measured CCT = 2775 K  
 Color Rendering Index CRI 82,2  
 Color Rendering Index, R9 (red component) R9 = 5,0  
 Color Rendering TM30-18 R<sub>f</sub> 83,3 – R<sub>g</sub> 90,1  
 Color Quality Scale CQS = 82,2

MacAdam Steps SDCM = 3,5  
 Color coordinates CIE 1931 (x;y) = (0,460;0,411)  
 Color coordinate CIEs 1960 (u;v) = (0,263;0,352)  
 Color deviation from BBL Duv = 0,0020  
 Color coordinate CIEs 1976 (CIELUV) (u';v') = (0,263;0,527)

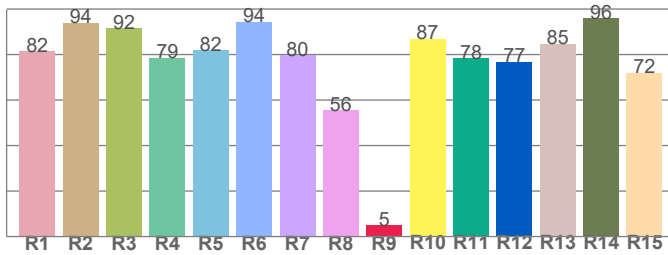
### CIE 1931



### CIE 1931 – zoomed on Planckian locus



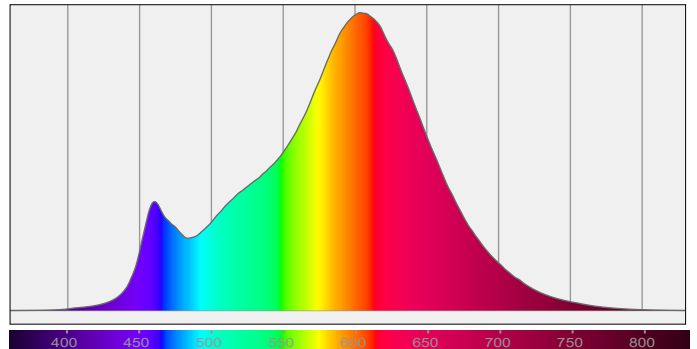
### Color Rendering Index per reference color (CIE 1995)



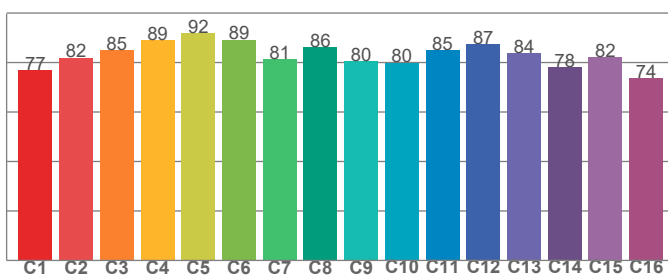
CRI R values, only R1-R8 are used to calculate final CRI value

R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
81,5	94,0	91,7	78,5	81,9	94,5	79,6	55,6	5,0	86,9	78,4	76,8	84,8	95,9	71,9

### Spectral power distribution (SPD) / W/nm – 0-100%



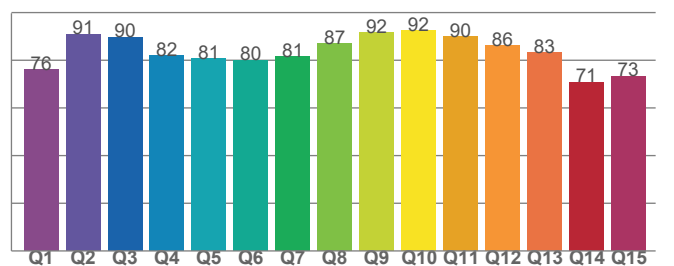
### TM30-18 R<sub>f</sub>-values per hue bin



TM30 C values, 16 binned values out of total of 99 C values

C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16
76,8	81,9	85,1	89,0	91,8	89,1	81,3	86,2	80,5	79,9	85,0	87,3	83,6	78,0	82,1	73,6

### Color Quality Scale by reference color



CQS Q values

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15
76,0	91,0	89,7	81,8	80,6	80,0	81,5	86,9	91,6	92,4	89,9	86,1	83,2	70,8	73,3

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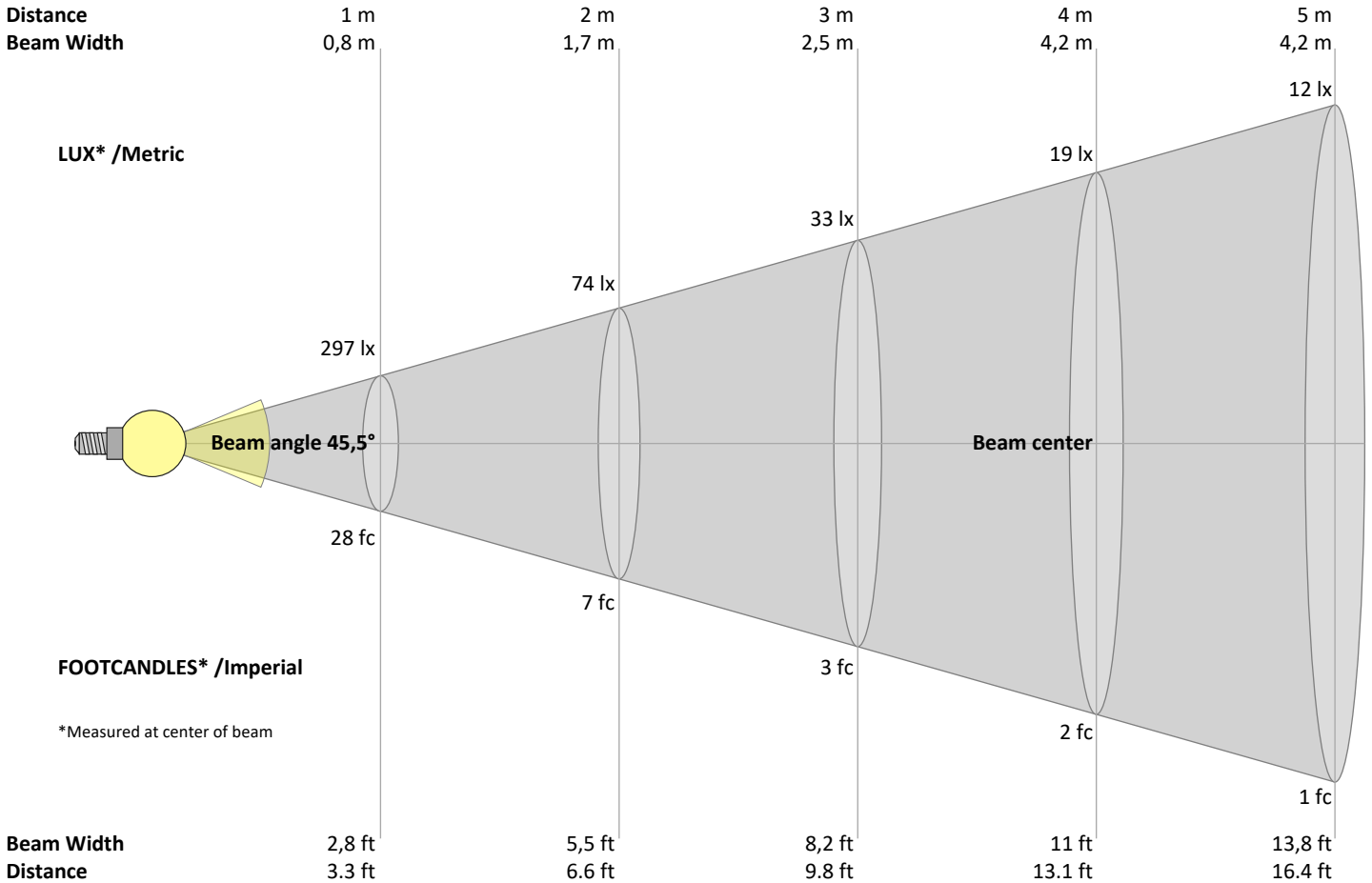
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## Beam Details



### Beam intensities from 1 – 20 m

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	m
3,3	6,6	9,8	13,1	16,4	19,7	23	26,2	29,5	32,8	36,1	39,4	42,7	45,9	49,2	52,5	55,8	59,1	62,3	65,6	ft
297	74	33	19	12	8	6	5	4	3	2	2	2	2	1	1	1	1	1	1	lux
27,6	6,9	3,1	1,7	1,1	0,8	0,6	0,4	0,3	0,3	0,2	0,2	0,2	0,1	0,1	0,1	0,1	0,1	0,1	0,1	fc

### Intensities in 0° c-plane

0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°	90°	95°	γ
297	288	252	210	171	132	99	77	58	42	30	21	15	10	7	4	3	2	1	1	cd
100%	97%	85%	71%	57%	44%	33%	26%	20%	14%	10%	7%	5%	3%	2%	1%	1%	1%	0%	0%	of 0°val

### Intensities in 90° c-plane

0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°	90°	95°	γ
297	288	252	210	171	132	99	77	58	42	30	21	15	10	7	4	3	2	1	1	cd
100%	97%	85%	71%	57%	44%	33%	26%	20%	14%	10%	7%	5%	3%	2%	1%	1%	1%	0%	0%	of 0°val

### Intensities in 180° c-plane

0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°	90°	95°	γ
297	288	252	210	171	132	99	77	58	42	30	21	15	10	7	4	3	2	1	1	cd
100%	97%	85%	71%	57%	44%	33%	26%	20%	14%	10%	7%	5%	3%	2%	1%	1%	1%	0%	0%	of 0°val

### Intensities in 270° c-plane

0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°	90°	95°	γ
297	288	252	210	171	132	99	77	58	42	30	21	15	10	7	4	3	2	1	1	cd
100%	97%	85%	71%	57%	44%	33%	26%	20%	14%	10%	7%	5%	3%	2%	1%	1%	1%	0%	0%	of 0°val

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Operator:



## Light Planning – UGR table

Uncorrected, comprehensive UGR table according to 117-1995

Reflectances		70	70	50	50	30	70	70	50	50	30
	ρ Ceiling	70	70	50	50	30	70	70	50	50	30
	ρ Walls	50	30	50	30	30	50	30	50	30	30
	ρ Floor	20	20	20	20	20	20	20	20	20	20
Room size		Viewed Crosswise					Viewed Endwise				
H = mounting height above eye level		(Viewing direction orthogonal to lamp length axis)					(Viewing direction parallel to lamp length axis)				
X	Y										
2H	2H	23,8	24,7	24,0	24,9	25,2	23,8	24,7	24,0	24,9	25,2
	3H	24,0	24,9	24,4	25,2	25,4	24,0	24,9	24,4	25,2	25,4
	4H	24,1	24,9	24,5	25,2	25,5	24,1	24,9	24,5	25,2	25,5
	6H	24,2	24,9	24,5	25,2	25,6	24,2	24,9	24,5	25,2	25,6
	8H	24,1	24,9	24,5	25,2	25,6	24,1	24,9	24,5	25,2	25,6
	12H	24,1	24,8	24,5	25,2	25,6	24,1	24,8	24,5	25,2	25,6
4H	2H	23,8	24,7	24,2	25,0	25,2	23,8	24,7	24,2	25,0	25,2
	3H	24,3	25,0	24,6	25,3	25,8	24,3	25,0	24,6	25,3	25,8
	4H	24,3	25,0	24,8	25,4	26,0	24,3	25,0	24,8	25,4	26,0
	6H	24,4	25,1	24,9	25,4	25,8	24,4	25,1	24,9	25,4	25,8
	8H	24,4	25,0	24,9	25,4	25,8	24,4	25,0	24,9	25,4	25,8
	12H	24,4	24,9	24,9	25,3	25,8	24,4	24,9	24,9	25,3	25,8
8H	4H	24,3	24,9	24,8	25,3	25,7	24,3	24,9	24,8	25,3	25,7
	6H	24,5	24,9	25,0	25,4	25,9	24,5	24,9	25,0	25,4	25,9
	8H	24,5	24,9	25,1	25,4	26,1	24,5	24,9	25,1	25,4	26,1
	12H	24,5	24,8	25,2	25,4	26,0	24,5	24,8	25,2	25,4	26,0
12H	4H	24,3	24,7	24,8	25,2	25,7	24,3	24,7	24,8	25,2	25,7
	6H	24,5	24,8	25,0	25,4	26,0	24,5	24,8	25,0	25,4	26,0
	8H	24,5	24,8	25,1	25,3	26,0	24,5	24,8	25,1	25,3	26,0

### Variations with the observer position for the luminaire spacings, S:

S = 1.0H	0,9 / -1,1	0,9 / -1,1
S = 1.5H	2,1 / -2,1	2,1 / -2,1
S = 2.0H	3,5 / -3,2	3,5 / -3,2

## Coefficients of Utilization

Ceiling reflectance	80			70			50			30			10			0		
Wall reflectance	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10	0
Floor reflectance	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	0
RCR	(RCR: Room Cavity Ratio)																	
	Room Values are expressed as percentage of Lumen delivered to the task surface																	
0	119	119	119	119	116	116	116	116	110	110	110	105	105	105	101	101	101	98
1	112	108	105	102	109	106	103	101	102	99	97	97	96	94	94	92	91	89
2	105	99	94	90	102	97	92	89	93	90	86	90	87	84	87	84	82	80
3	98	90	84	80	96	89	83	79	86	81	77	83	79	76	81	77	75	73
4	92	83	77	72	90	82	76	71	79	74	70	77	73	69	75	71	68	66
5	87	77	70	65	85	76	69	65	74	68	64	72	67	63	70	66	62	61
6	82	71	64	59	80	70	64	59	69	63	59	67	62	58	66	61	58	56
7	77	67	60	55	76	66	59	55	64	58	54	63	58	54	62	57	53	52
8	73	62	55	51	72	62	55	51	60	54	50	59	54	50	58	53	50	48
9	69	58	52	47	68	58	52	47	57	51	47	56	50	47	55	50	46	45
10	66	55	49	44	65	55	48	44	54	48	44	53	47	44	52	47	44	42

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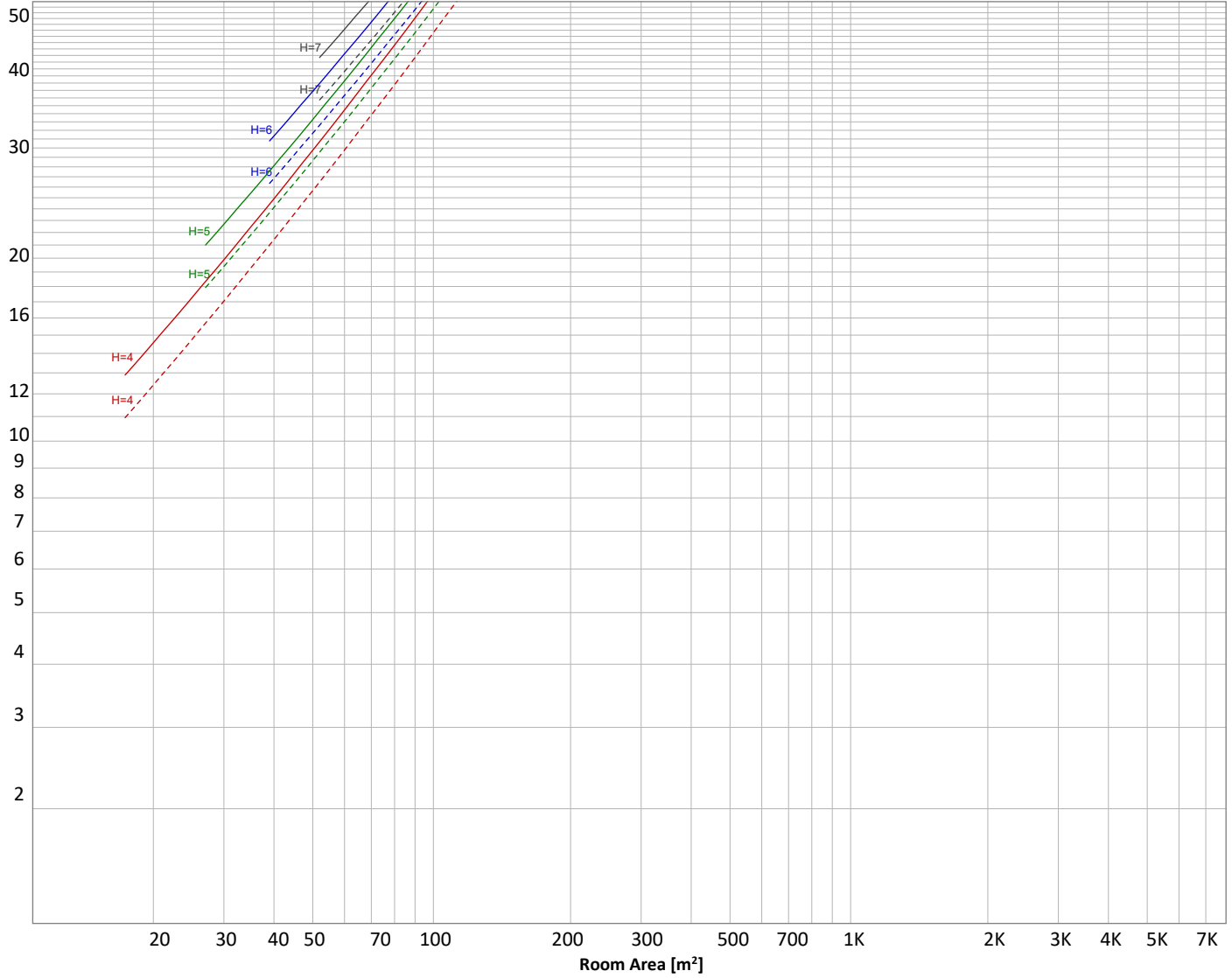
Operator:



## Luminaire budgetary diagram

Uncorrected, comprehensive UGR table according to 117-1995

LAMPS (number of lamps)



### Conditions

H = Room height	Flux = 264 lm	$\rho(\%)$			
H <sub>down</sub> = Lamp distance from ceiling =	0.00 m	Line type	Ceiling reflectance	Wall reflectance	Floor reflectance
H <sub>work</sub> = Work area height from floor =	0.00 m	-----	70	50	30
E <sub>work</sub> = Average lux on work area =	100 lx	_____	50	30	20

### Zonal Lumen Summary

0°-10°	10°-20°	20°-30°	30°-40°	40°-50°	50°-60°	60°-70°	70°-80°	80°-90°
26,4 lm	58,3 lm	60,0 lm	47,8 lm	32,4 lm	19,0 lm	9,88 lm	4,55 lm	1,77 lm
90°-100°	100°-110°	110°-120°	120°-130°	130°-140°	140°-150°	150°-160°	160°-170°	170°-180°
1,02 lm	0,870 lm	0,693 lm	0,492 lm	0,356 lm	0,270 lm	0,201 lm	0,086 lm	0,015 lm

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## Outdoor Light Planning

### Lumen per Zone

Zone (γ)	Lumen	% Total
0-10°	26 lm	10,0%
10-20°	58 lm	22,1%
20-30°	60 lm	22,7%
30-40°	48 lm	18,1%
40-50°	32 lm	12,3%
50-60°	19 lm	7,2%
60-70°	10 lm	3,7%
70-80°	5 lm	1,7%
80-90°	2 lm	0,7%
90-100°	1 lm	0,4%
100-110°	1 lm	0,3%
110-120°	1 lm	0,3%
120-130°	0 lm	0,2%
130-140°	0 lm	0,1%
140-150°	0 lm	0,1%
150-160°	0 lm	0,1%
160-170°	0 lm	0,0%
170-180°	0 lm	0,0%
<b>Total</b>	<b>264 lm</b>	<b>100,0%</b>

### Intensity peaks

Max intensity	297 cd
Intensity, 90°	1 cd
Intensity, 0°	297 cd

### Zonal Lumen summary

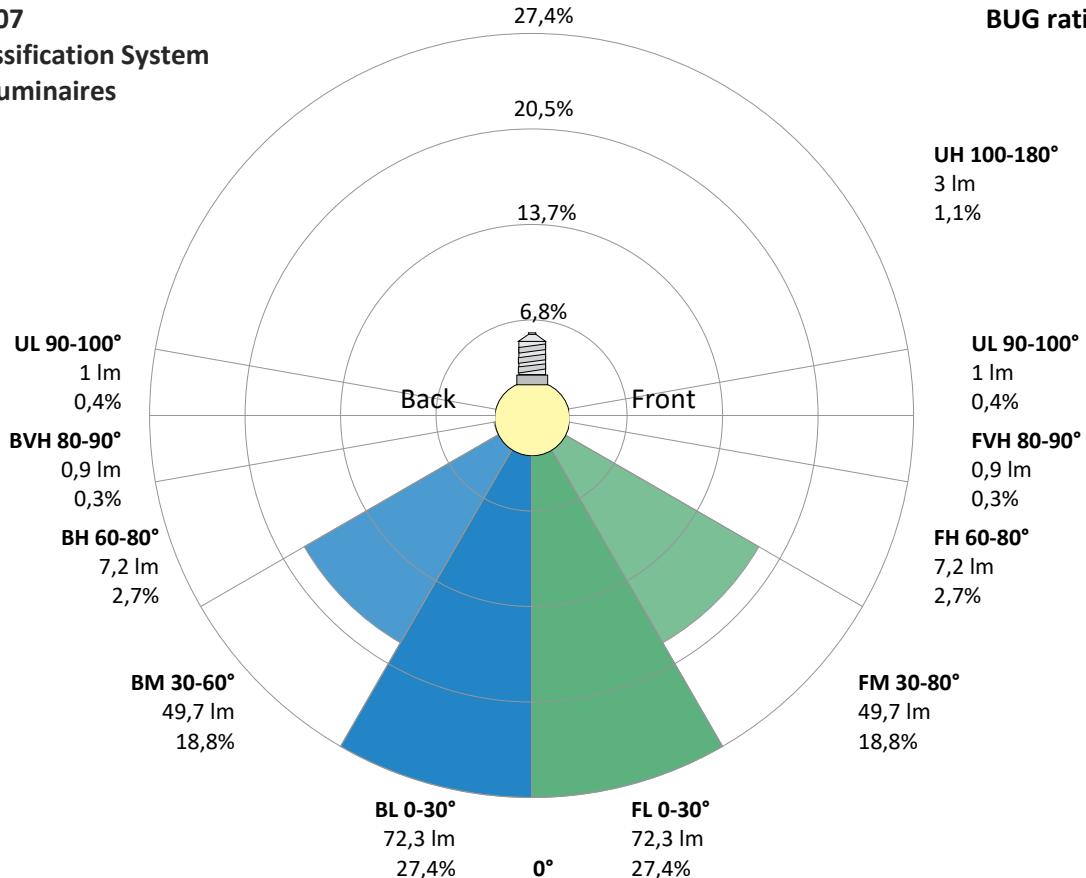
Zone (γ)	Lumen	% Total
0-30°	145 lm	54,8%
0-40°	193 lm	72,9%
0-60°	244 lm	92,4%
60-90°	16 lm	6,1%
70-100°	7 lm	2,8%
90-120°	3 lm	1,0%
0-90°	260 lm	98,5%
90-180°	4 lm	1,5%
0-180°	264 lm	100,0%

### BUG rating

	Lumen	% Total
<b>Forward light</b>		
Low(0-30°)	72 lm	27,4%
Medium(30-60°)	50 lm	18,8%
High(60-80°)	7 lm	2,7%
Very high(80-90°)	1 lm	0,3%
<b>Back light</b>		
Low(0-30°)	72 lm	27,4%
Medium(30-60°)	50 lm	18,8%
High(60-80°)	7 lm	2,7%
Very high(80-90°)	1 lm	0,3%
<b>Uplight</b>		
Low(90-100°)	1 lm	0,4%
High(100-180°)	3 lm	1,1%

## IESNA TM-15-07 Luminaire Classification System For Outdoor Luminaires

**BUG rating B0 U1 G0**



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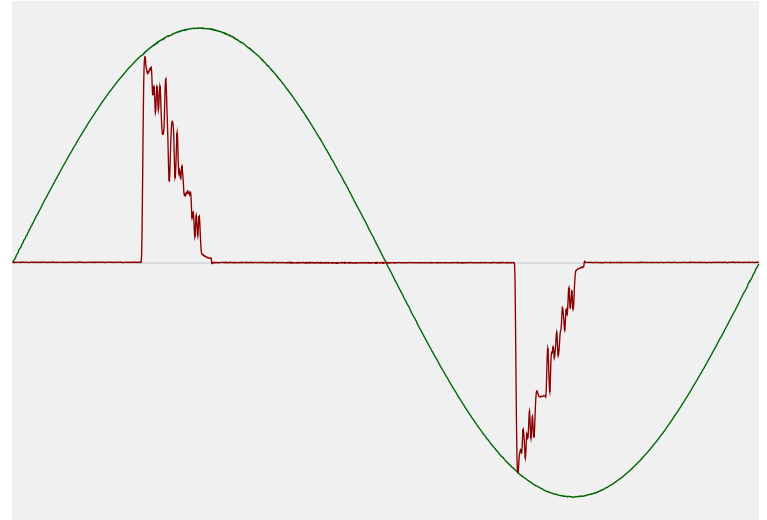


## Power Details

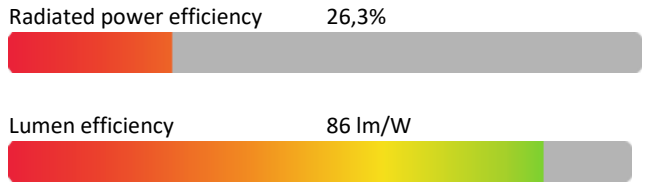
### Input Power

Power feed to light source	3,1 W
Frequency of input power	50 Hz
RMS Input voltage feed, $V_{RMS}$	230 V
RMS Input current feed, $I_{RMS}$	0,028 A
Volt-Ampere or apparent power = $V_{RMS} * I_{RMS}$	6,39 VA
Displacement factor of AC power feed	0,96
Power factor of AC current feed	0,48
Total harmonic distortion of the current	162,67%
Total harmonic distortion of the voltage	0,08%

### Input Power Curve



### Efficiency



## Stabilization Details

### Warmup Conditions

Stable period	15 min
Stable change max	2,0%
Minimum time	15 min

### Color Temperature Change

CCT start	2670 K
CCT shift	+30 K
CCT end	2700 K

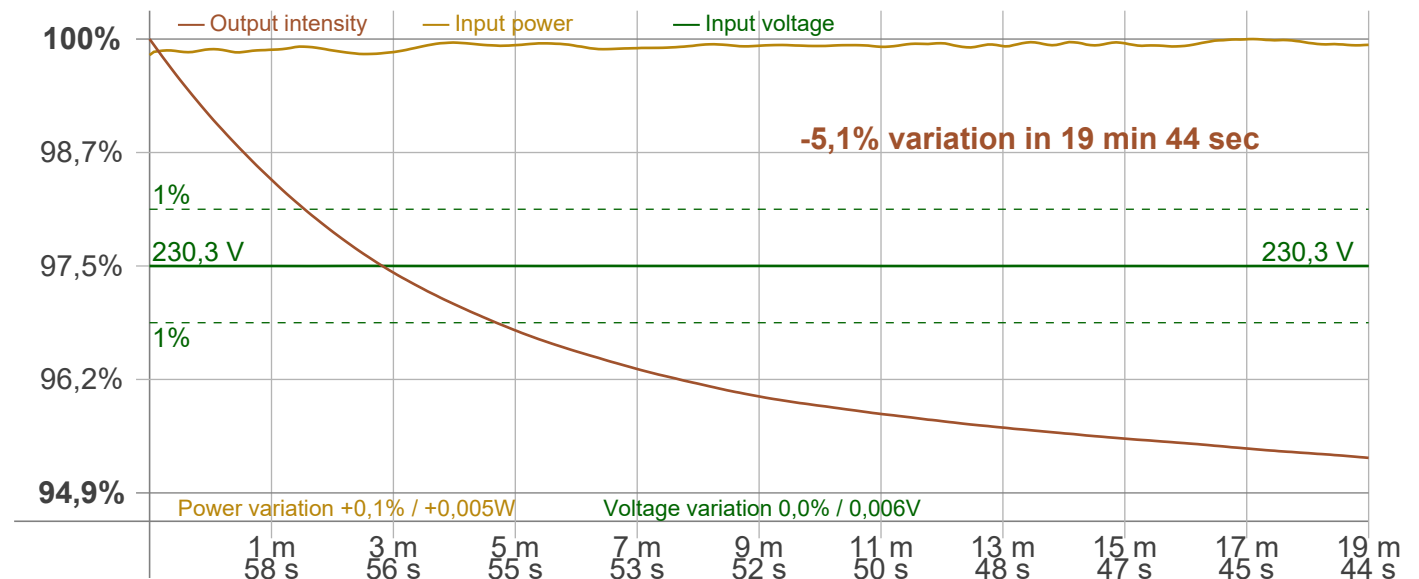
### Warmup Result

Total warmup time	Lamp stabilized in 19 min 44 sec
Warmup variation	-5,1%

### Output Change

Output start	278 lm
Output change	-14 lm
Output end	264 lm

### Stabilization Curve



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Operator:



## Flicker /TLA details

Flicker Meter Type Viso Systems LabFlicker  
 Frequency of input power 50 Hz  
 Flicker/TLA sample rate 20000 samples/s

**Measurement time**  
 PstLM 180 sec  
 All other indices 1,2 sec

### Flicker indices according to Illuminating Engineering Society (IES)

Flicker frequency 100 Hz  
 Percent Flicker 0,9 %  
 Flicker index 0

### Flicker indices according to California Energy Commission (CEC) 2016b

JA8/10 40 Hz 0,01 %  
 JA8/10 90 Hz 0,02 %  
 JA8/10 200 Hz 0,79 %  
 JA8/10 400 Hz 0,93 %  
 JA8/10 1000 Hz 0,9 %

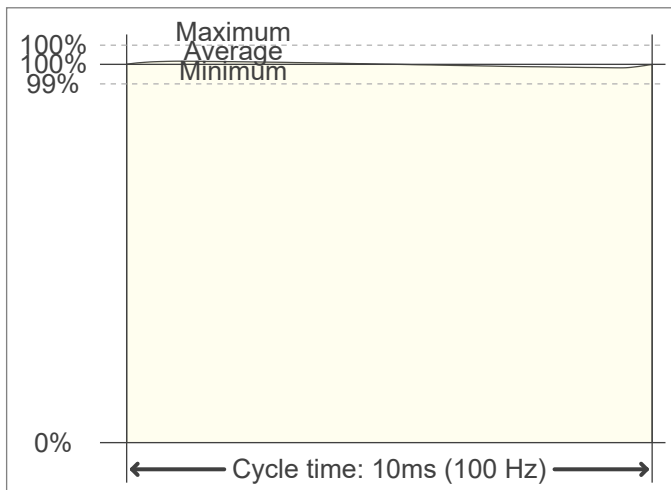
### TLA indices (re IEC TR 61547-1, IEC 61000-3-3 and IEC 61000-4-15)

PstLM value (F < 80 Hz) 0,01  
 SVM value (80 < F < 2000 Hz) 0,03

### Flicker indices according to Lighting Research Center (2015)

Perception metric, Assist Mp 0,01

### Flicker frame (frame of one flicker period in time domain)



### Flicker FFT (flicker curve in frequency domain)



### IEEE 1789 Frequency/modulation plot

