

# Light Measurement Report

Print date: 04-09-2024

Measurement date and time: 04-09-2024 08:32:52 – Measurement no. VFR-240904-3763-MS

Operator: Jakob Daugaard Jepsen

## Laboratory and Equipment

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

Ingemann Components, Denmark  
Viso Systems LabSpion – Type C, horizontal  
LabSensor – 22-08-2023 – 1130826259

## 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

24 planes – 15°  
3,75°  
4,00 m  
5,1 W – PF 0,48 – DPF 1,0  
225 V – 0,047 A  
50 Hz  
Lamp stabilized in 15 min 1 sec – 2,0%

## Tested Light Source

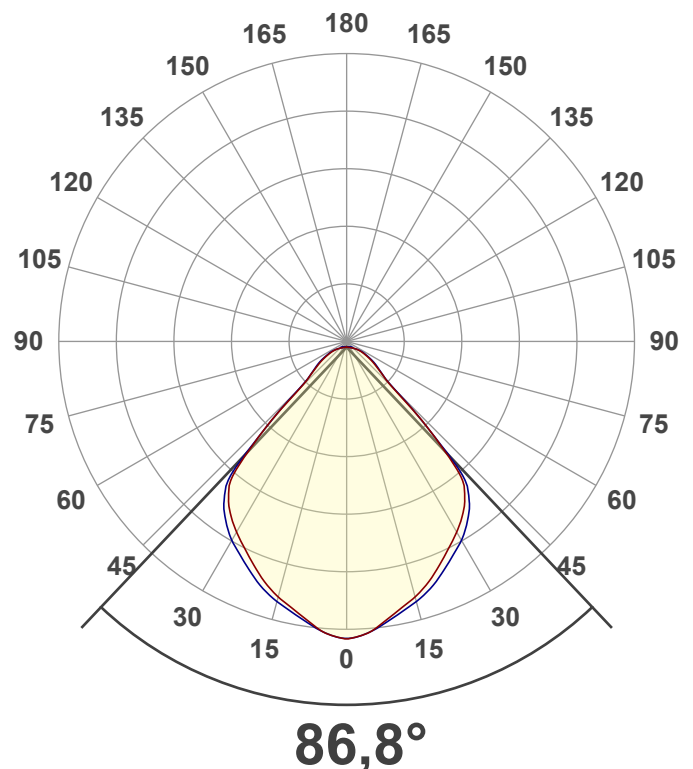
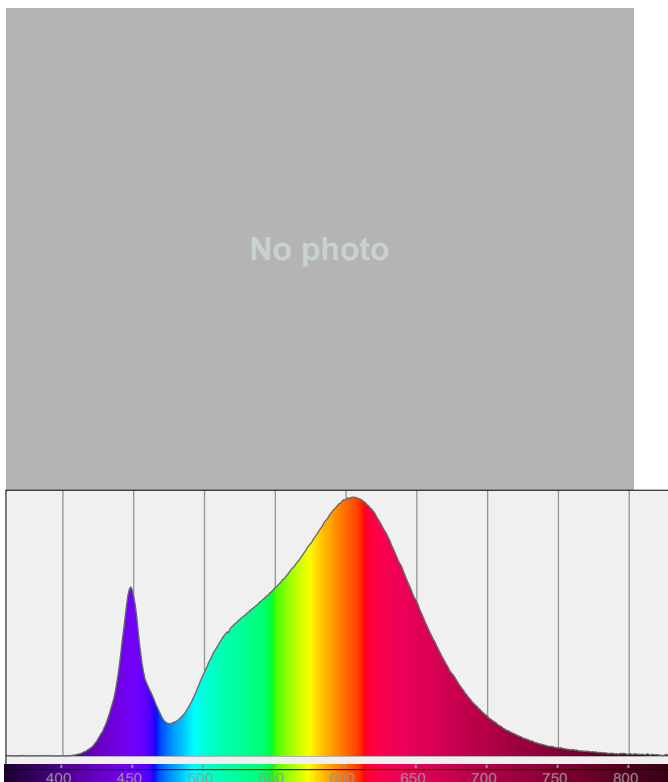
Product Name  
Item No. and Manufacturer  
Product Description (line 1)

Twist Floor Lamp  
Pendant – Hay

## 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

503 lm – 0,08% / 99,92%  
99 lm/W  
290 cd – 86,8°  
CCT = 3085 K / 3085 K  
CRI 82,7  
 $R_f$  83,7 –  $R_g$  98,7  
Duv 0,0006 – SDCM n/a  
SVM 0 – PstLM 0,01



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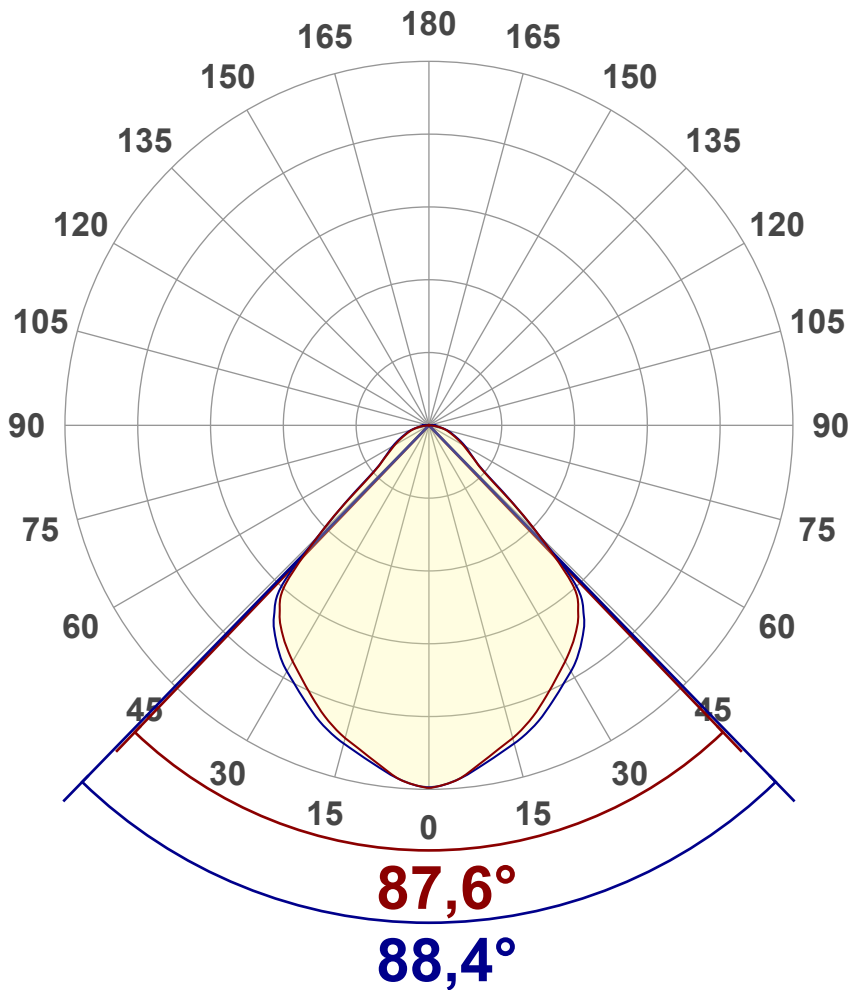
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## Luminous Intensity diagram

Unit: 0-100% of peak intensity



## Main Values

Output (total Lumen) 503 lm  
Lumen Up% / Down% 0,08% / 99,92%  
Peak Intensity 290 cd

## Beam angle

Average (50%) 86,8°

## Cut-off Angle

Average 2,5% 163°

## Field Angle

Average 10% 124,8°

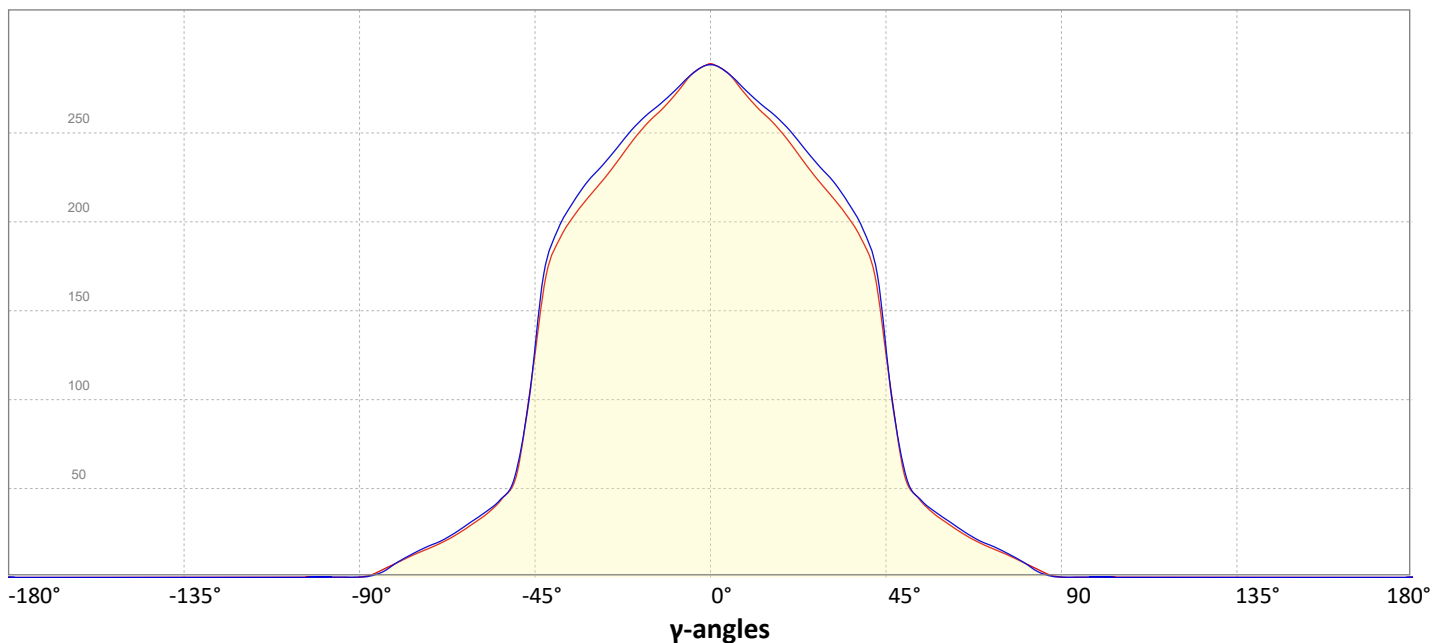
## Intensity Ratio

In 120° cone 91,2%  
In 90° cone 77,0%

**C000-C180**

**C090-C270**

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



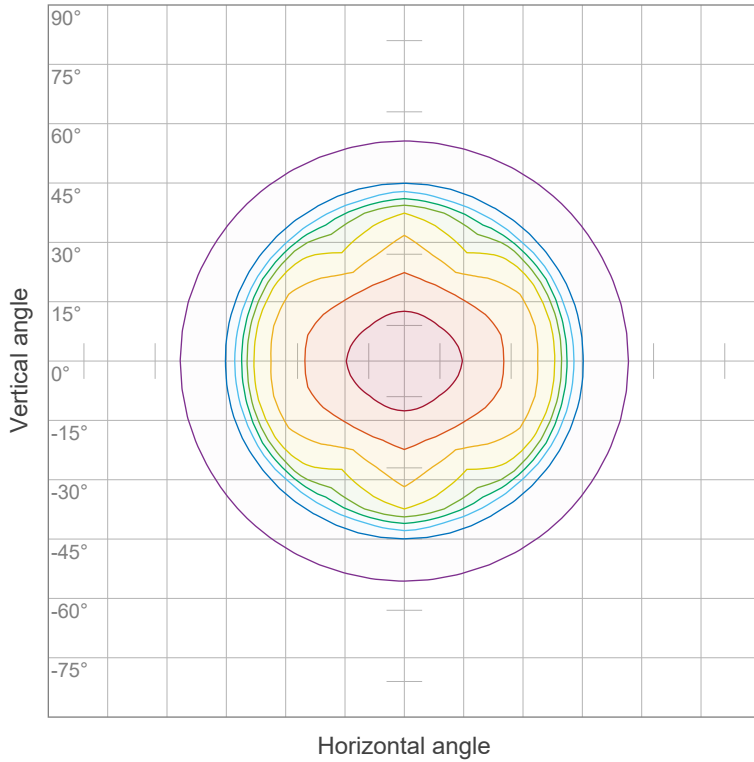
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## Iso-intensity Diagram (Iso-candela)

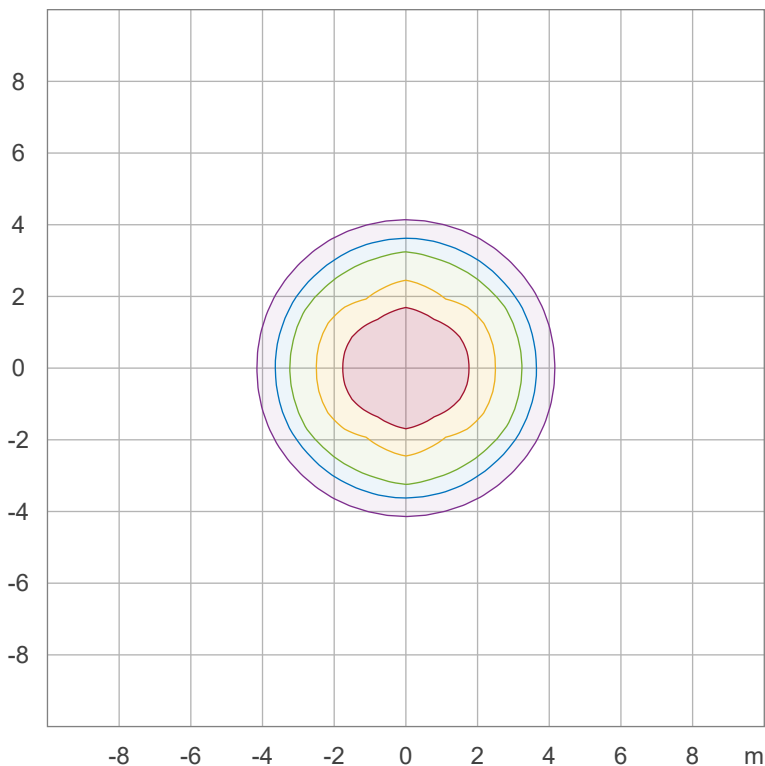


90 %	260,1 cd
80 %	231,2 cd
70 %	202,3 cd
60 %	173,4 cd
50 %	144,5 cd
40 %	115,6 cd
30 %	86,7 cd
20 %	57,8 cd
10 %	28,9 cd

Peak intensity: 289,0 cd

Number of c-planes: 24

## Iso-illuminance Diagram (Iso-lux)



50,0 %	16,1 lx
30,0 %	9,6 lx
10,0 %	3,2 lx
5,0 %	1,6 lx
3,0 %	1,0 lx

Peak illuminance: 32,1 lx

Mounting height: 3,0 m

Number of c-planes: 24

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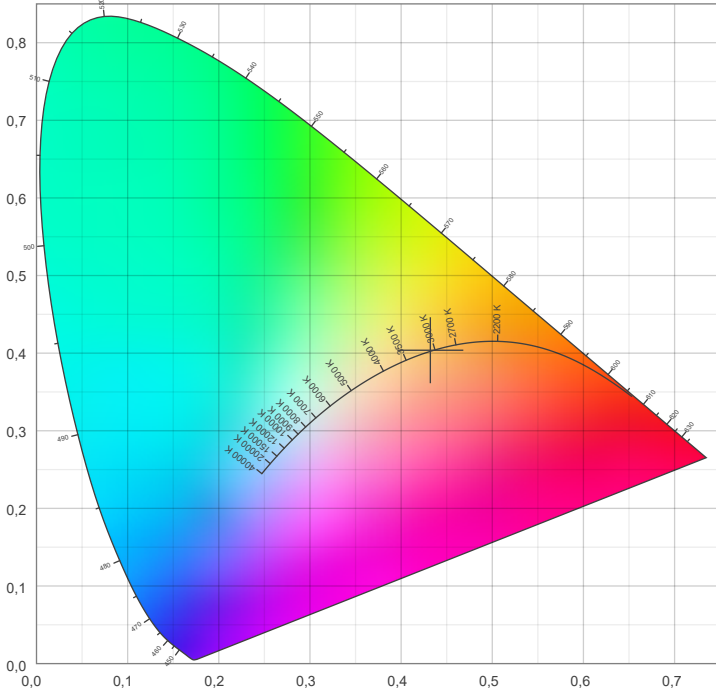


## Color details

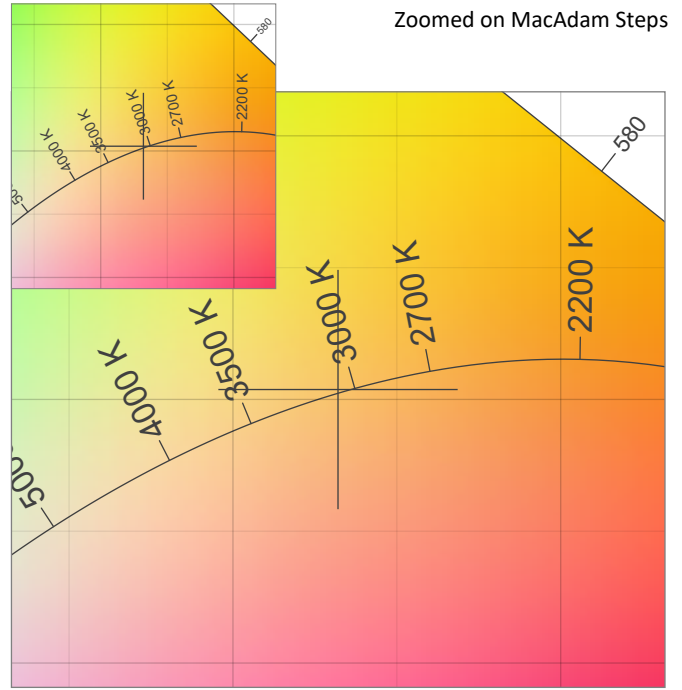
Correlated Color Temperature, Target CCT = 3085 K  
 Correlated Color Temperature, Measured CCT = 3085 K  
 Color Rendering Index CRI 82,7  
 Color Rendering Index, R9 (red component) R9 = 10,3  
 Color Rendering TM30-18 R<sub>f</sub> 83,7 – R<sub>g</sub> 98,7  
 Color Quality Scale CQS = 81,7

MacAdam Steps  
 Color coordinates CIE 1931 (x;y) = (0,432;0,404)  
 Color coordinate CIEs 1960 (u;v) = (0,248;0,347)  
 Color deviation from BBL Duv = 0,0006  
 Color coordinate CIEs 1976 (CIELUV) (u';v') = (0,248;0,521)  
 SDCM = n/a

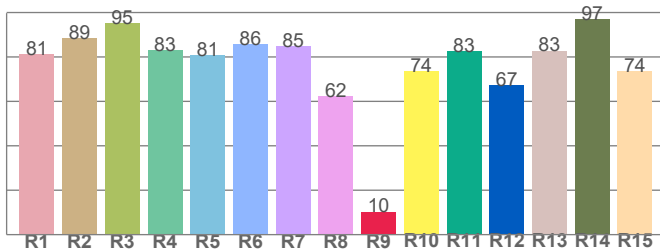
### CIE 1931



### CIE 1931 – zoomed on Planckian locus



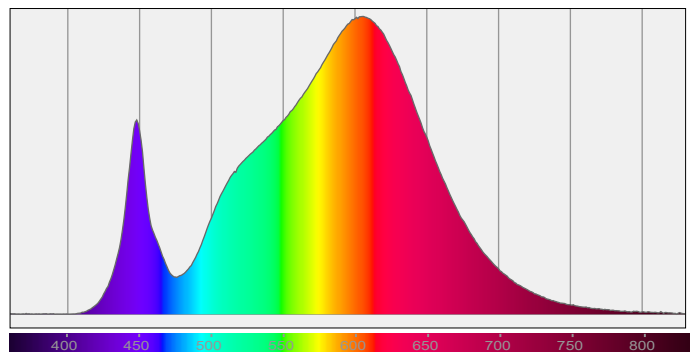
### Color Rendering Index per reference color (CIE 1995)



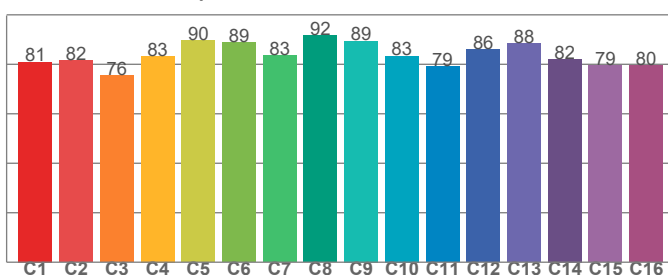
CRI R values, only R1-R8 are used to calculate final CRI value

R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
81,3	88,6	95,1	82,9	80,9	85,6	84,9	62,3	10,3	73,6	82,7	67,3	82,8	97,0	73,6

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



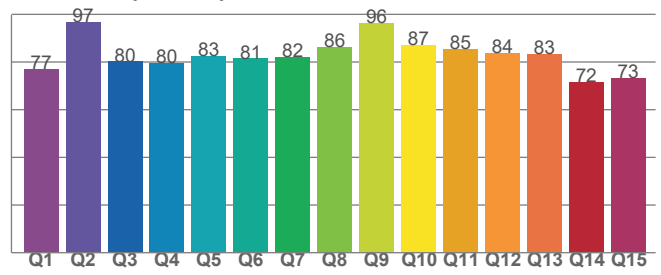
### TM30-18 Rf-values per hue bin



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
81,0	81,5	75,6	83,3	89,5	88,9	83,5	91,6	89,5	83,4	79,1	86,0	88,4	82,1	79,4	79,6

### Color Quality Scale by reference color



CQS Q values

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15
77,2	96,7	80,2	79,7	82,5	81,4	82,0	86,2	96,4	87,2	85,3	83,8	83,3	71,6	73,4

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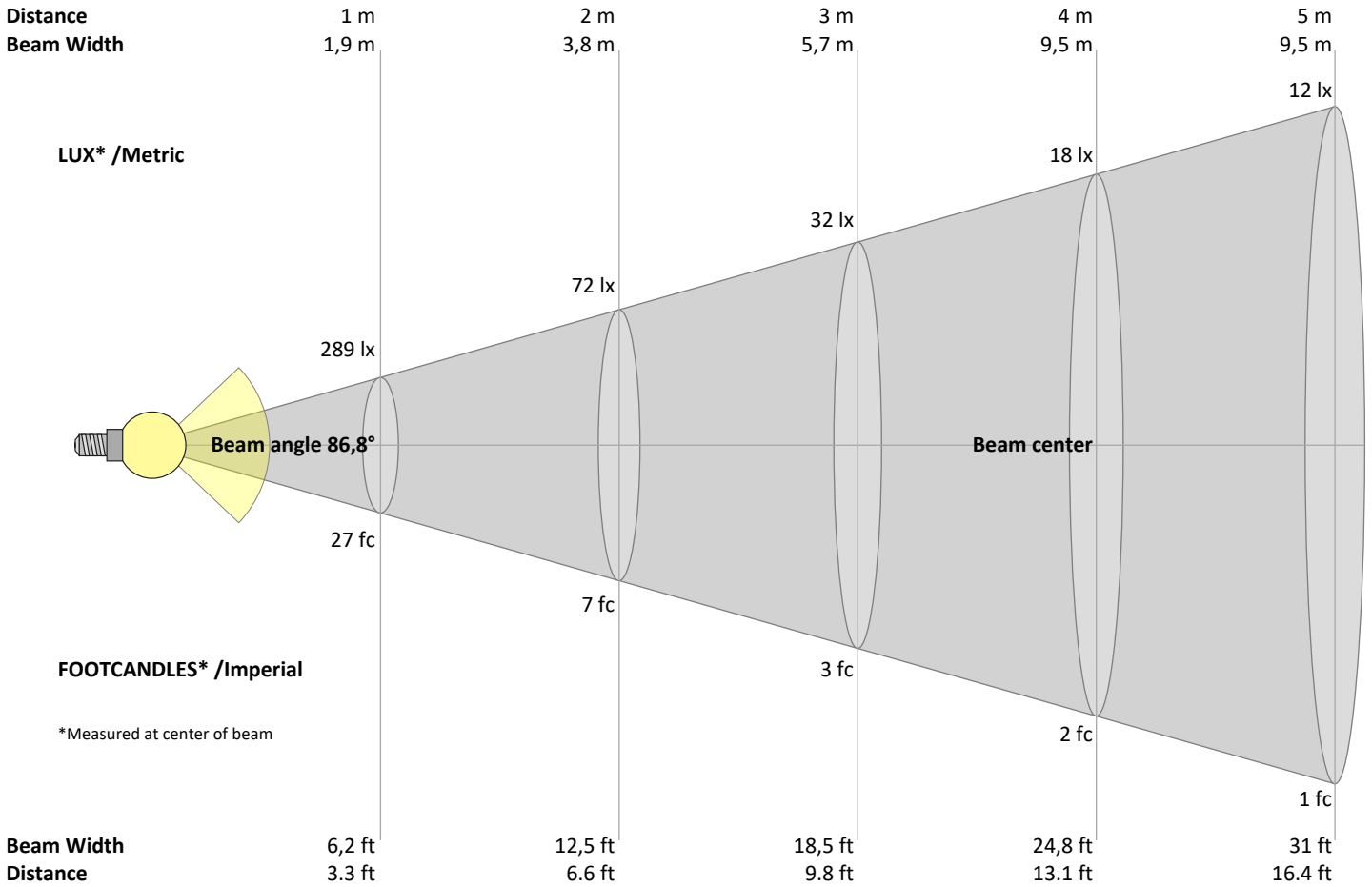
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## Beam Details



### 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
289	72	32	18	12	8	6	5	4	3	2	2	2	1	1	1	1	1	1	1	lux
26,8	6,7	3	1,7	1,1	0,7	0,5	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
289	282	269	258	245	231	217	203	182	125	57	41	32	24	19	14	9	3	0	0	cd
100%	98%	93%	89%	85%	80%	75%	70%	63%	43%	20%	14%	11%	8%	6%	5%	3%	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
289	283	272	262	252	239	226	212	189	129	59	42	33	26	20	15	9	2	0	0	cd
100%	98%	94%	91%	87%	83%	78%	73%	66%	45%	21%	14%	12%	9%	7%	5%	3%	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
289	282	269	258	245	231	217	203	182	125	57	41	32	24	19	14	9	3	0	0	cd
100%	98%	93%	89%	85%	80%	75%	70%	63%	43%	20%	14%	11%	8%	6%	5%	3%	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
289	283	272	262	252	239	226	212	189	129	59	42	33	26	20	15	9	2	0	0	cd
100%	98%	94%	91%	87%	83%	78%	73%	66%	45%	21%	14%	12%	9%	7%	5%	3%	1%	0%	0%	of 0°val

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## 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	13,3	14,2	13,5	14,5	14,7	13,9	14,8	14,0	15,1	15,3
	3H	13,8	14,8	14,2	15,1	15,2	14,3	15,3	14,7	15,6	15,8
	4H	14,1	15,1	14,5	15,4	15,6	14,6	15,6	15,0	15,9	16,1
	6H	14,5	15,3	14,8	15,6	16,0	15,0	15,8	15,3	16,1	16,5
	8H	14,6	15,4	14,9	15,7	16,1	15,0	15,8	15,4	16,1	16,5
	12H	14,6	15,4	15,0	15,7	16,2	15,0	15,8	15,4	16,2	16,6
4H	2H	13,4	14,4	13,8	14,6	14,9	13,9	14,9	14,3	15,1	15,4
	3H	14,3	15,1	14,6	15,4	15,8	14,7	15,5	15,1	15,9	16,3
	4H	14,7	15,4	15,1	15,8	16,3	15,1	15,8	15,6	16,3	16,8
	6H	15,1	15,8	15,6	16,2	16,5	15,5	16,2	16,0	16,6	16,9
	8H	15,2	15,9	15,8	16,3	16,6	15,6	16,3	16,1	16,6	17,0
	12H	15,3	15,9	15,8	16,3	16,7	15,7	16,2	16,2	16,6	17,1
8H	4H	14,9	15,5	15,4	15,9	16,3	15,3	15,9	15,8	16,3	16,7
	6H	15,4	15,9	16,0	16,4	16,9	15,8	16,3	16,3	16,8	17,3
	8H	15,7	16,1	16,2	16,6	17,3	16,0	16,4	16,5	16,9	17,6
	12H	15,8	16,2	16,4	16,7	17,3	16,1	16,5	16,7	17,0	17,6
12H	4H	14,9	15,4	15,4	15,8	16,3	15,3	15,8	15,8	16,2	16,7
	6H	15,5	15,9	16,0	16,4	17,1	15,9	16,3	16,4	16,8	17,4
	8H	15,8	16,1	16,4	16,6	17,2	16,1	16,4	16,7	16,9	17,5

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

S = 1.0H	0,8 / -0,7	0,8 / -0,9
S = 1.5H	1,9 / -1,0	2,1 / -1,2
S = 2.0H	3,1 / -1,4	3,4 / -1,5

## 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	111	111	111	106	106	106	102	102	102	100
1	111	107	104	101	108	105	102	99	101	98	96	97	95	93	94	92	90	88
2	103	97	91	86	101	95	90	85	91	87	83	88	85	82	85	82	80	78
3	96	87	80	75	94	86	79	74	83	78	73	80	76	72	78	74	71	69
4	89	79	72	66	87	78	71	66	75	70	65	73	68	64	71	67	63	61
5	83	72	64	59	81	71	64	58	69	63	58	67	62	57	65	61	57	55
6	77	66	58	53	76	65	58	52	63	57	52	62	56	52	60	55	51	49
7	72	61	53	48	71	60	53	47	58	52	47	57	51	47	56	50	46	45
8	68	56	48	43	66	55	48	43	54	47	43	53	47	43	52	46	42	41
9	64	52	44	39	62	51	44	39	50	44	39	49	43	39	48	43	39	37
10	60	48	41	36	59	48	41	36	47	40	36	46	40	36	45	40	36	34

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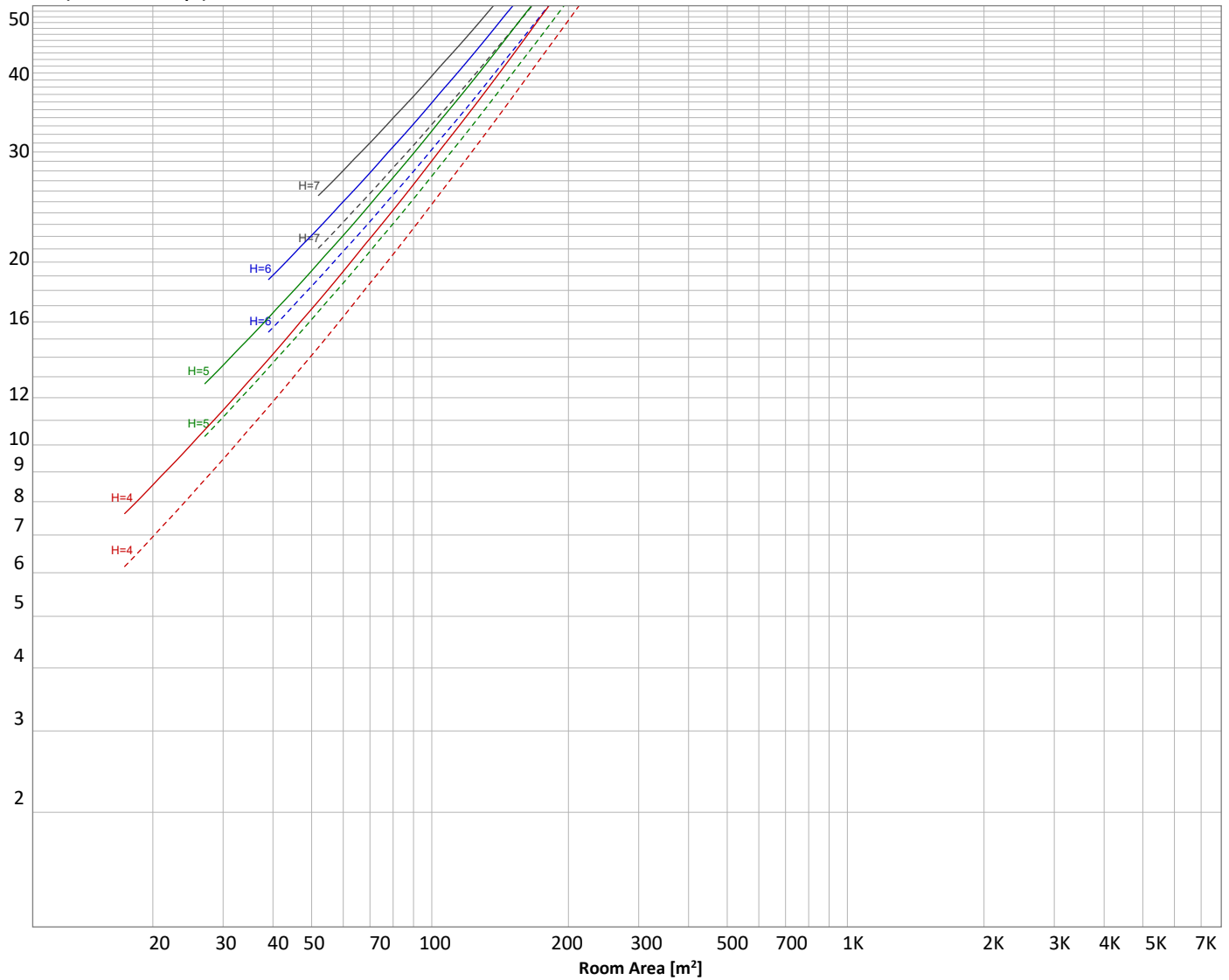
Operator: Jakob Daugaard Jepsen



## Luminaire budgetary diagram

Uncorrected, comprehensive UGR table according to 117-1995

LAMPS (number of lamps)



### Conditions

H = Room height	Flux = 503 lm	ρ(%)			
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°
26,5 lm	73,0 lm	106 lm	123 lm	91,5 lm	37,9 lm	25,0 lm	15,0 lm	4,02 lm
90°-100°	100°-110°	110°-120°	120°-130°	130°-140°	140°-150°	150°-160°	160°-170°	170°-180°
0,184 lm	0,102 lm	0,062 lm	0,032 lm	0,020 lm	0,009 lm	0,006 lm	0,003 lm	0,001 lm

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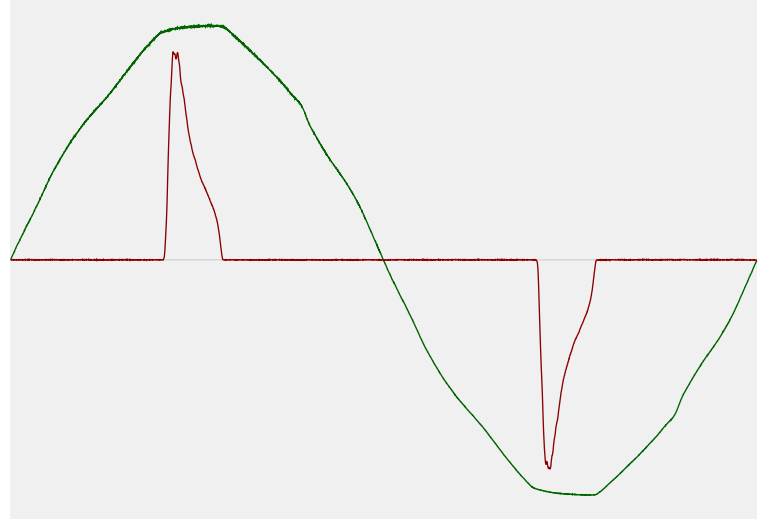
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## Power Details

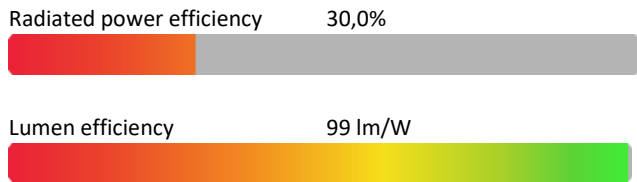
### Input Power

Power feed to light source	5,1 W
Frequency of input power	50 Hz
RMS Input voltage feed, $V_{RMS}$	225 V
RMS Input current feed, $I_{RMS}$	0,047 A
Volt-Ampere or apparent power = $V_{RMS} * I_{RMS}$	10,48 VA
Displacement factor of AC power feed	1,0
Power factor of AC current feed	0,48
Total harmonic distortion of the current	179,49%
Total harmonic distortion of the voltage	2,13%

### 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	3085 K
CCT shift	+0 K
CCT end	3085 K

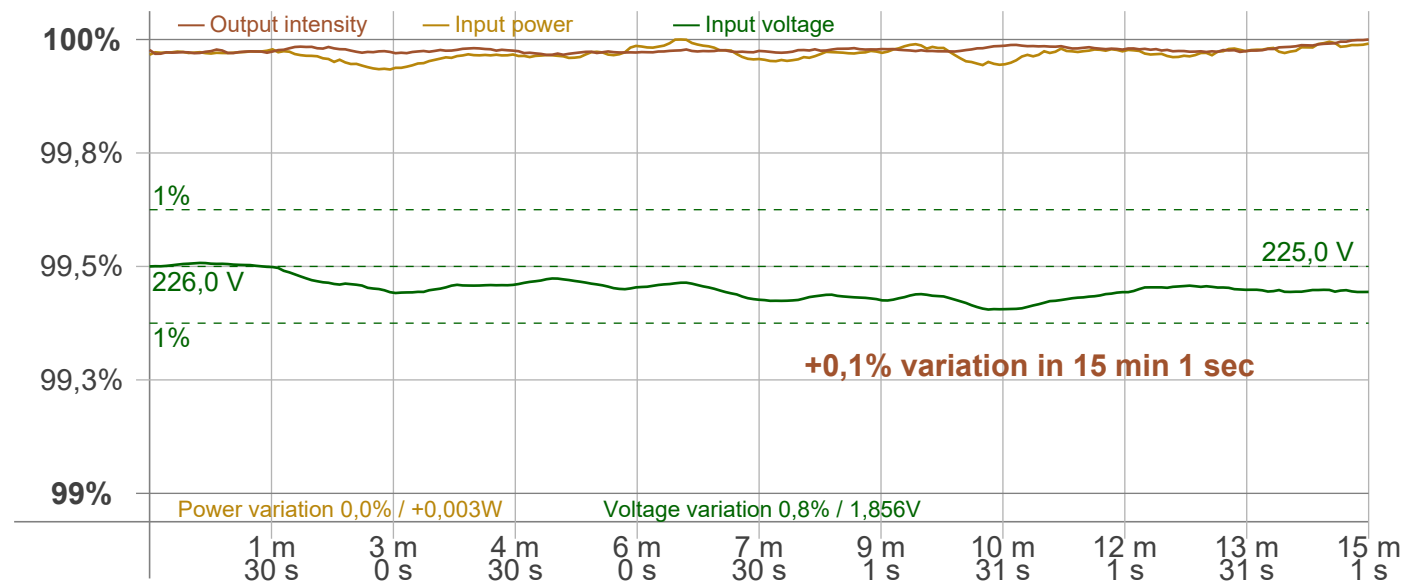
### Warmup Result

Total warmup time	Lamp stabilized in 15 min 1 sec
Warmup variation	+0,1%

### Output Change

Output start	503 lm
Output change	+ lm
Output end	503 lm

### Stabilization Curve



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## 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 50 Hz  
 Percent Flicker 0,11 %  
 Flicker index 0

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

JA8/10 40 Hz 0,04 %  
 JA8/10 90 Hz 0,06 %  
 JA8/10 200 Hz 0,08 %  
 JA8/10 400 Hz 0,09 %  
 JA8/10 1000 Hz 0,1 %

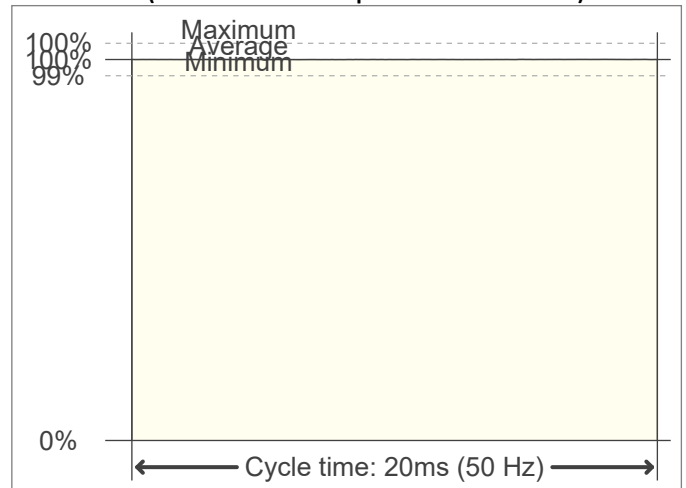
### Flicker indices according to Lighting Research Center (2015)

Perception metric, Assist Mp 0,01

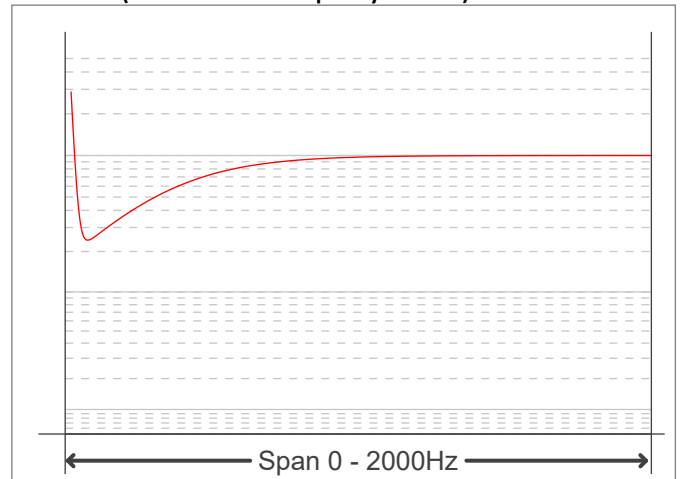
### TLA indices (re IEC TR 61547-1, IEC 61000-3-3 and IEC 61000-4-15)

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

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



Flicker FFT (flicker curve in frequency domain)



### Compliance with EU Ecodesign directive

Regulation EU 2019/2020 on Directive 2009/125/EC (Ecodesign Directive) defines two evaluation variables for Temporal Light Artefacts (TLA): The PstLM for the evaluation of visible flicker in the frequency range 0.3Hz to 80Hz. "st" stands for "short term", and "LM" stands for "light flicker meter method". The "stroboscopic visibility measure" SVM for evaluating the stroboscopic effect on moving objects in the frequency range 80Hz to 2000Hz. For both parameters, a value of 1 means that an average observer recognises the flicker with a probability of 50%. The permissible limits are 1 for PstLM and 0.4 for SVM.

PstLM value 0,01 Compliant

SVM value 0,00 Compliant

**Product total Compliant**