

THE BASICS OF LIGHT

By Modular Lighting Instruments

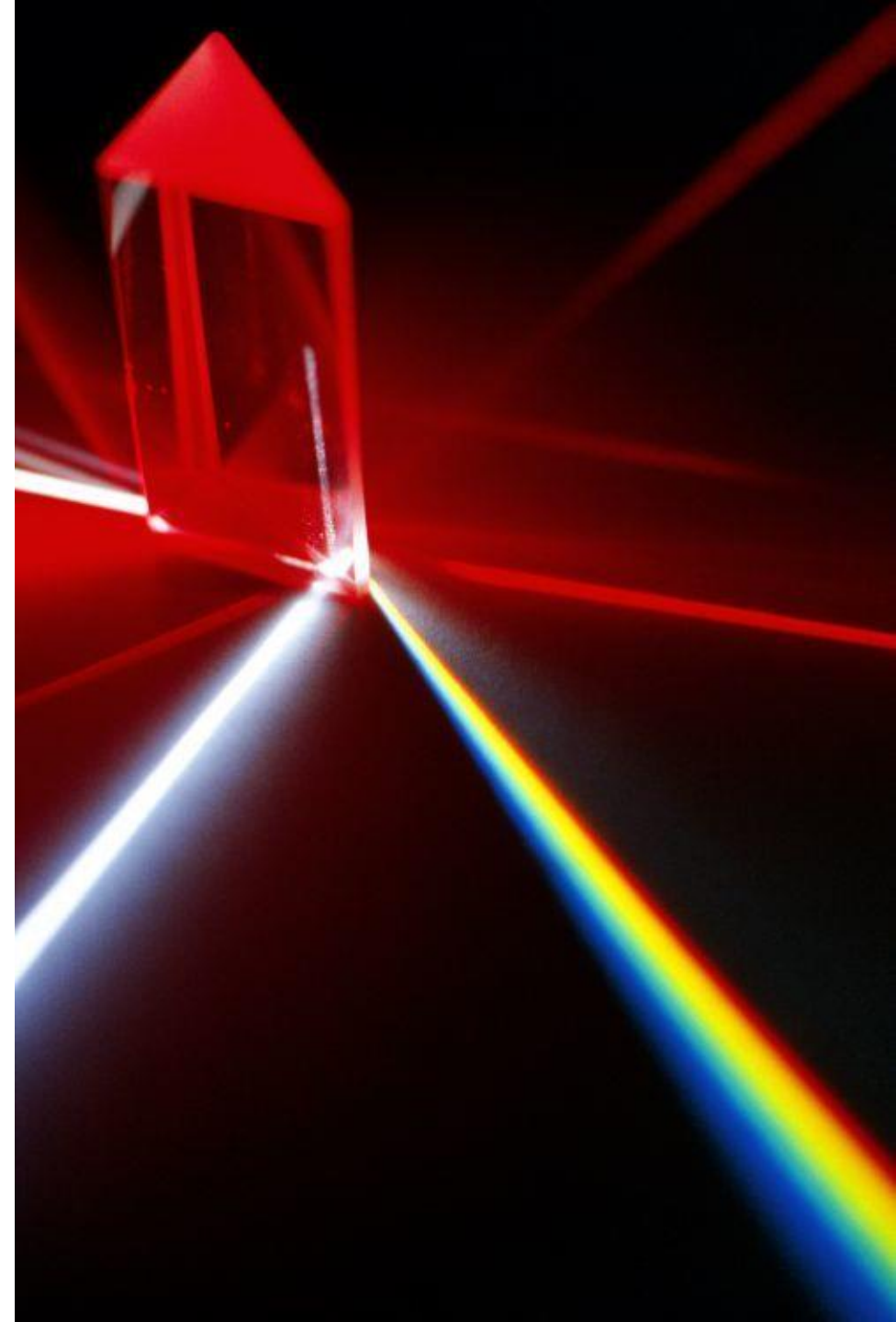
THE BASICS OF LIGHT

- What is light?
- Correlated Color Temperature CCT
- CRI vs TM-30-15

WHAT IS LIGHT

A prism can be used to show the seven colours of the spectrum that make up white light

When white light shines through a prism, each colour refracts at a slightly different angle



VISIBLE LIGHT

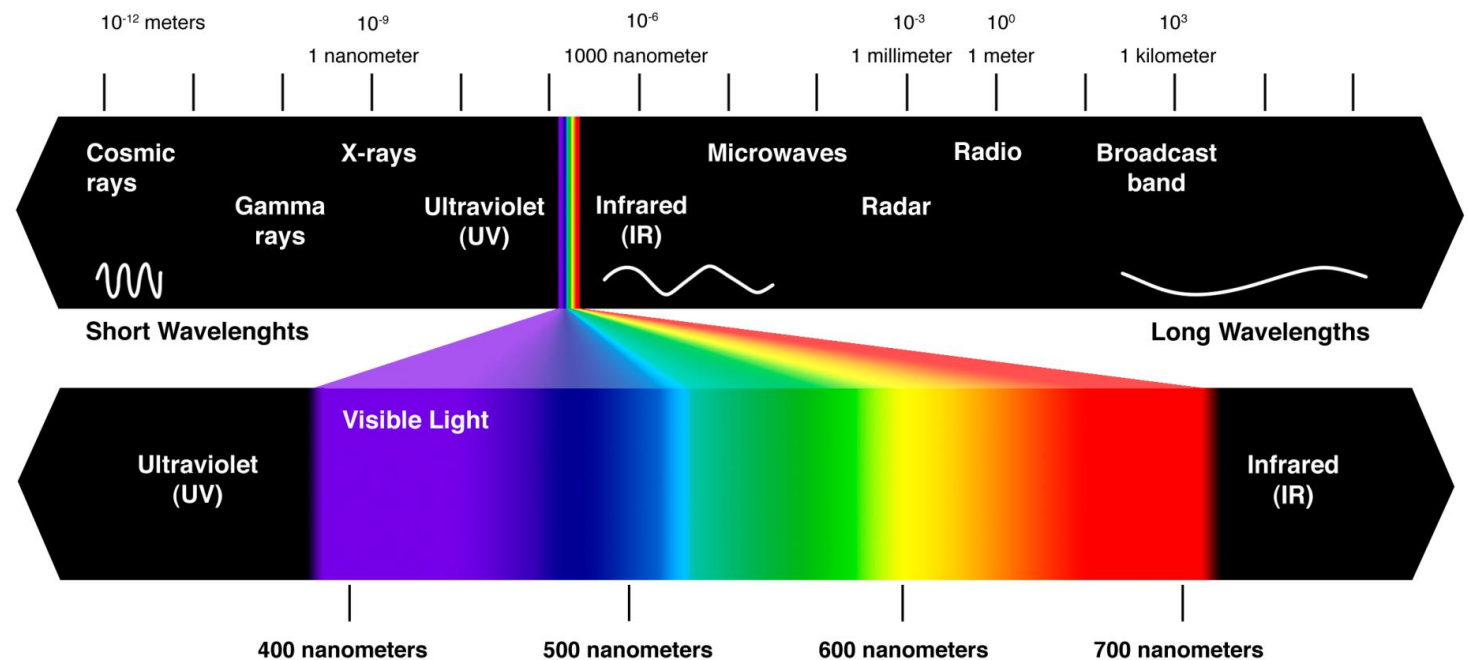
Electromagnetic radiation that can be detected by the human eye

We're blind creatures

Electromagnetic radiation occurs over an extremely wide range of wavelengths.

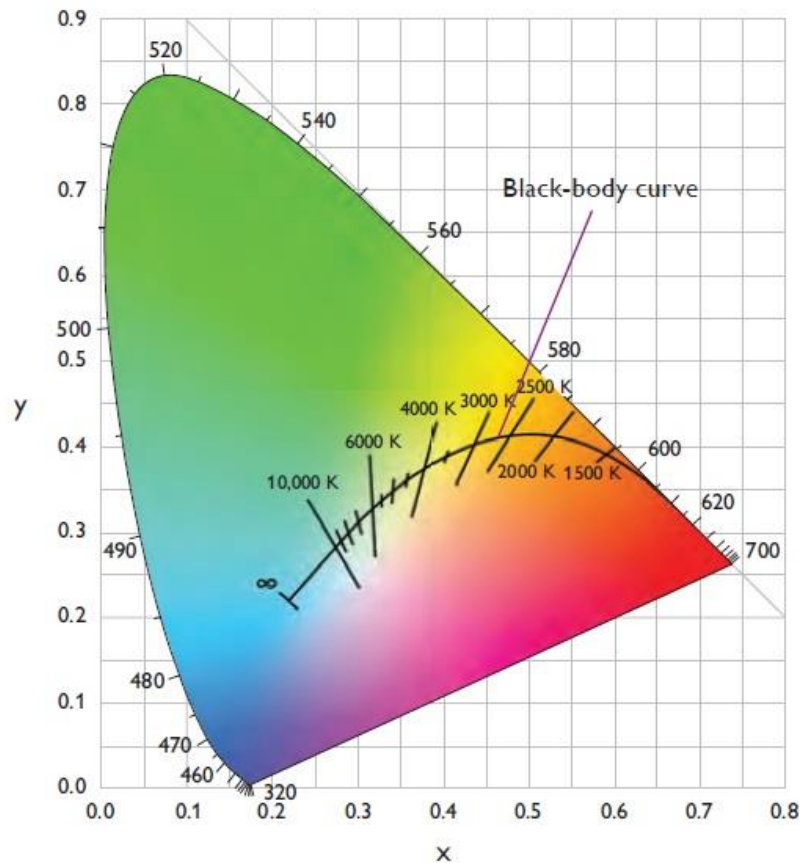
Most of the wavelengths around us is invisible to us

Visible spectrum between UV & IR Light



CIE 1931

The chromaticity diagram, a graphical representation of visible light spectrum



It shows:

- x/y **colour coordinates**
- **Wavelengths** in nanometres
- **Black-body curve** (shows white – visible- light)
- **Correlated color Temperature (CCT)**

CORRELATED COLOR TEMPERATURE CCT (Kelvin)

Measure of light source colour appearance

Correlated color temperature is defined by the spectrum.

High CCT = cool white

Low CCT = warm white

The colour temperature of light strongly affects our senses and emotions

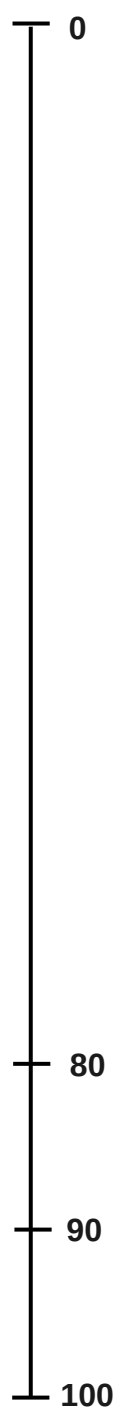


CRI

Measurement of how colours look under a light source.

The **higher** the CRI, the **more natural** the colours appear

MODULAR's standard for light quality: CRI > 90



CRI
index
rendering
colour

**Light begins at
90+**





CRI

8 colour measurements

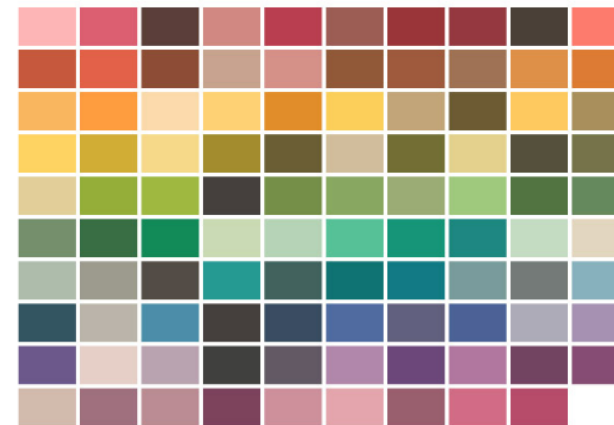
Last revision was **22 years ago** by CIE
(commission Internationale de l'Eclairage)

Shows only information about color fidelity

CRI
index
rendering
colour



TM-30-15
Method of evaluating colour rendition



TM-30

99 colour measurements

New method to measure colour rendering by IES
(Illuminating Engineering Society)

Rf = fidelity Index (similar to CRI)

Rg = gamut index to show saturation

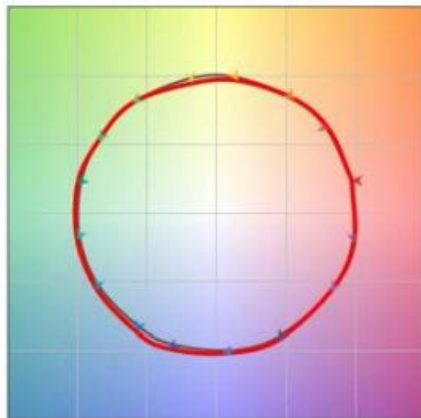
Color Vector Graphic (Visual graphic on hue and saturation)

TM-30-15

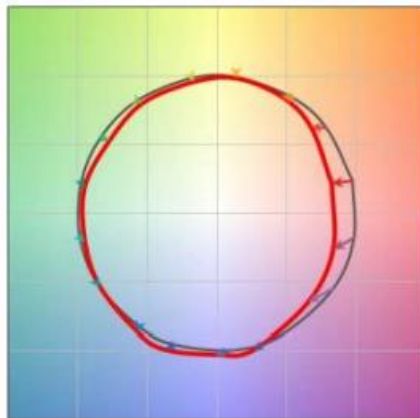
Method of evaluating colour rendition



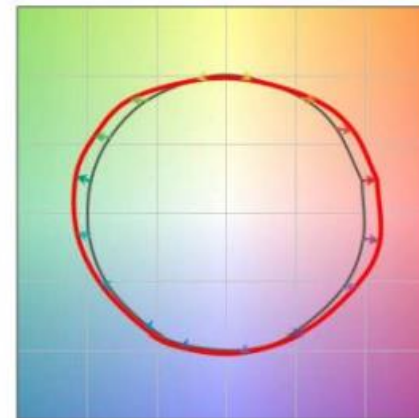
CRI95
 $R_f = 93$
 $R_g = 100$



CRI80
 $R_f = 78$
 $R_g = 90$



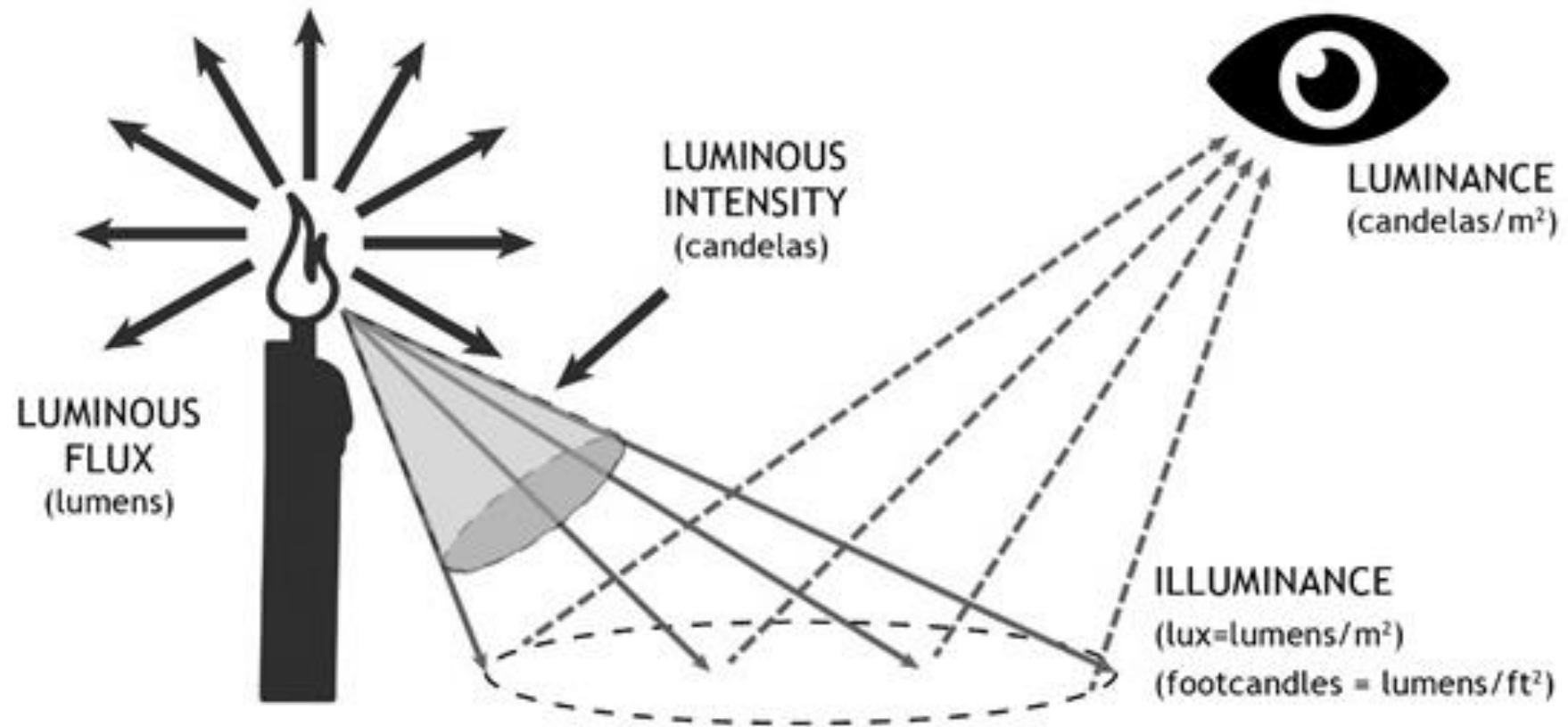
CRI80
 $R_f = 78$
 $R_g = 110$

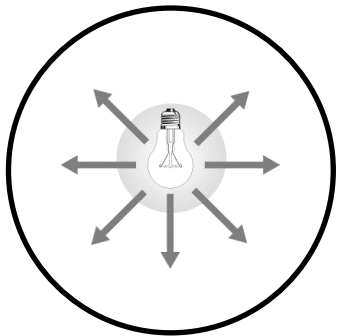


The color vector graphics provides additional information about the particular colors that would tend to appear more saturated than others.

These vector graphics are crucial because 2 LEDs with identical R_g values of 100 could have different effects on an object's appearance.

TERMINOLOGY

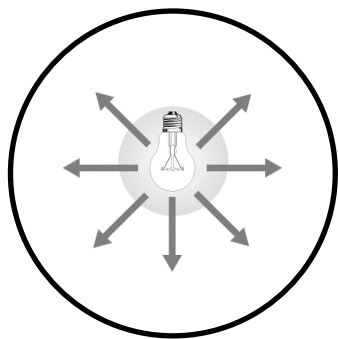




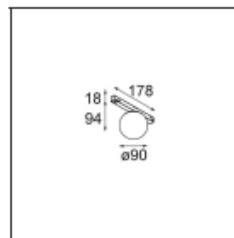
LUMINOUS FLUX Φ (lumen)

The amount of visible radiation a lightsource emits in all directions per second





Gamin Track 48V 90 1x LED 2700K DALI DI Black Structure



Specifications

Specifications

Material	13600132
Light Source Type	LED
LED Type	BRIDGELUX V8G8
LED technology	LED COB
CRI	Min. 90
Colour Temperature	2700K
Lifetime	L80B20 @50,000 Hours
Lamp Included	Yes
Number of Light Sources	1
CIE flux code	27 53 78 65 67
Binning (SDCM)	2
Light Direction	Down
Input Voltage	48Vdc
Luminaire power (W)	9
Electrical Class	III
IP Rating	20
Glow wire rating (°)	960
Dimming Protocol	DALI
Indoor/Outdoor	Indoor
Application	Ceiling, Wall
Adjustability	Not Applicable
Distance to Lighted Object (m)	0,1
Primary Colour & Primary Finish	Black, Structure
Gross weight (g)	422
Delivered lumens (lm)	588
Efficacy (lm/W)	69
Glare rating	23

DFF (downward flux fraction)

= DLOR (downlight output ratio) / LOR (light output ratio)

Flux code N1 N2 N3 N4 N5

LOR (light output ratio)

Efficiency= 67%

Luminaire luminous flux = 588lm

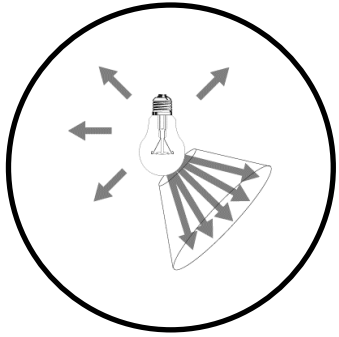
Lamp luminous flux = 871lm

LOR = 67%

(downward)luminaire luminous flux /lamp luminous flux

Luminaire luminous flux = 588lm

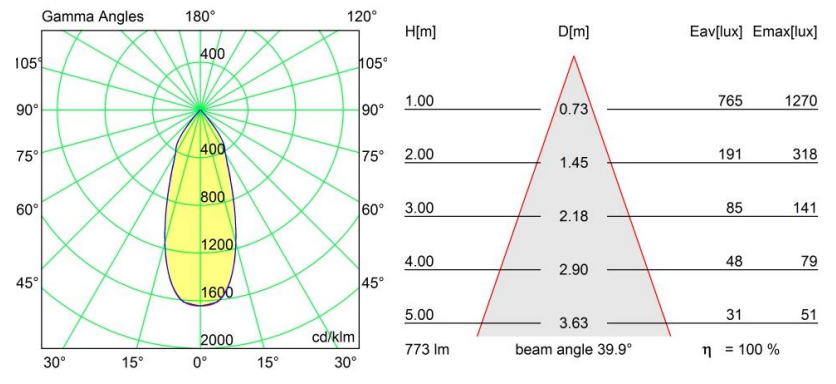
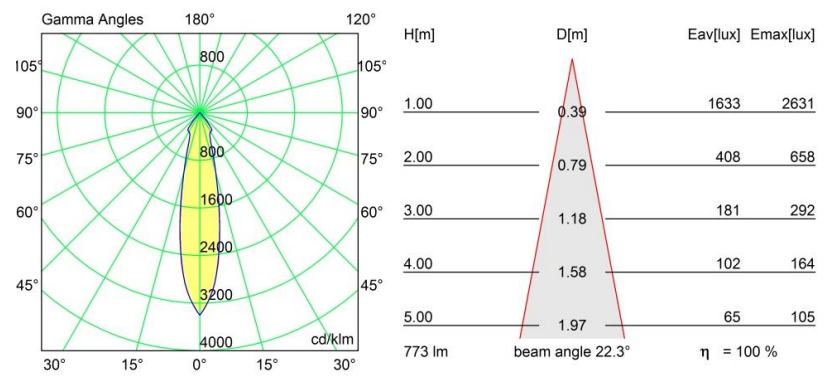
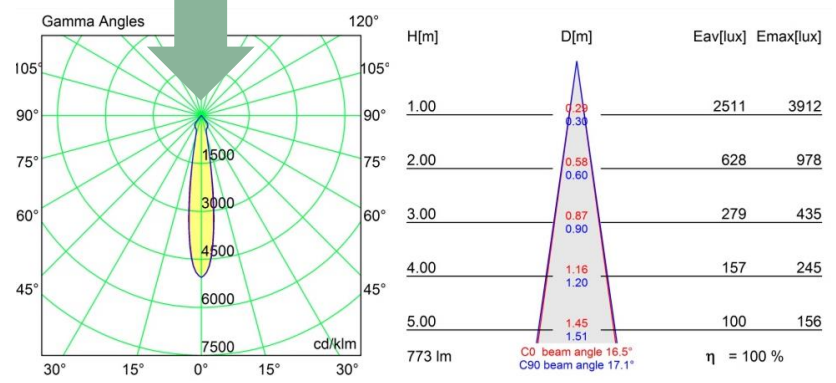
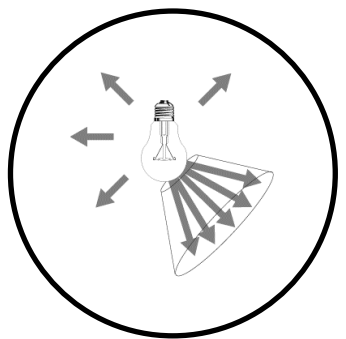
Efficacy= 69lm/W



LUMINOUS INTENSITY I (candela)

Indicates how the luminous intensity is distributed in the various directions





SPOT

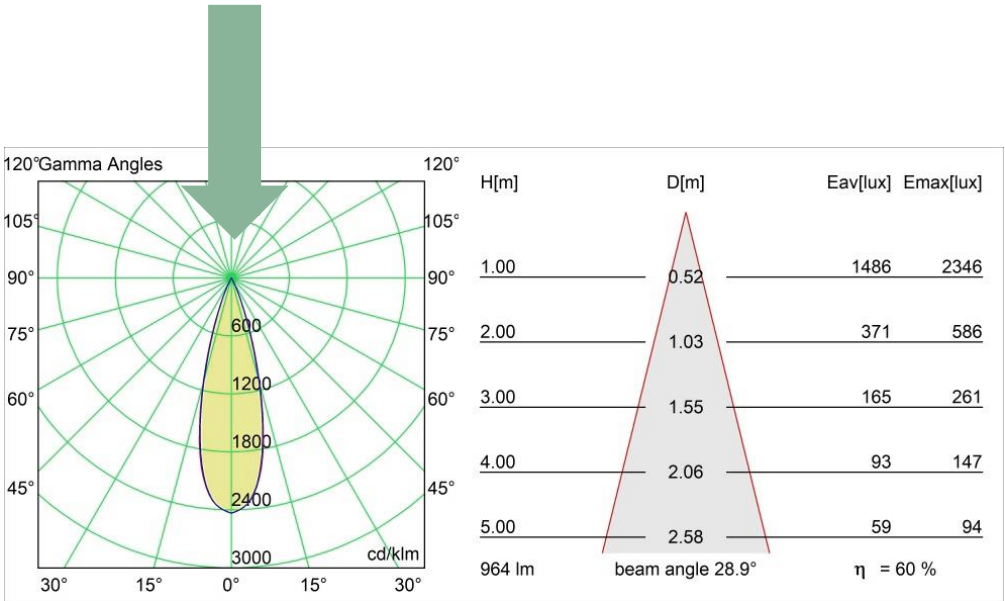
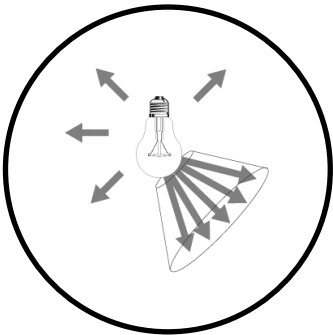
MEDIUM

FLOOD

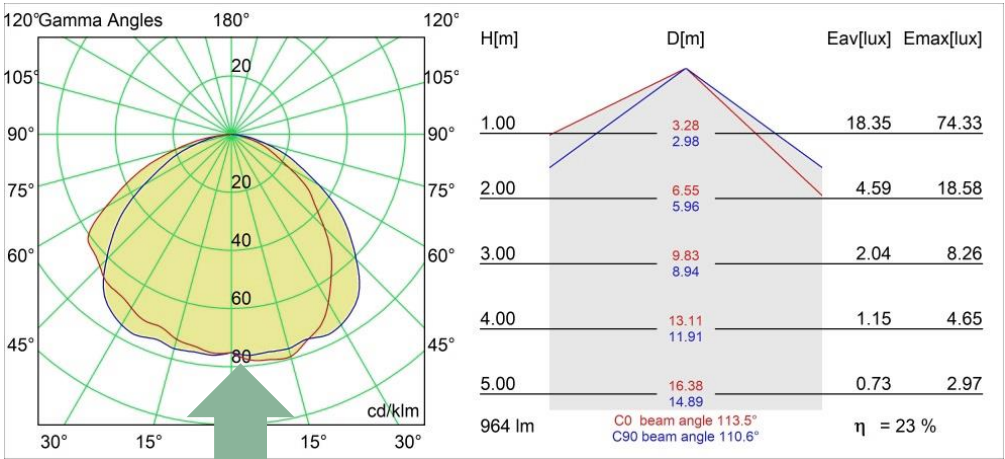
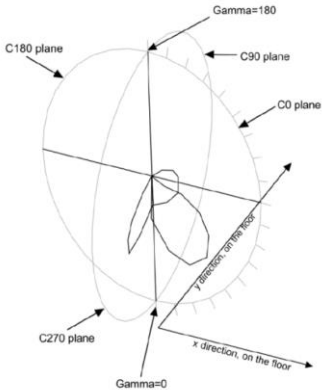
Smart Kup Recessed 82 1x

LED 3000K White Structure

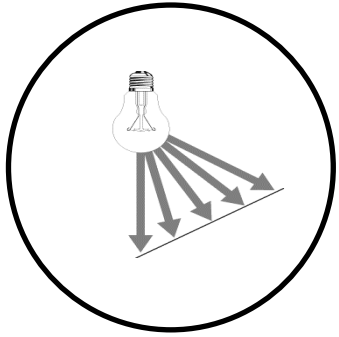




Luminaire luminous flux	565 lm
Light output ratio	58.6 %
Connected load	8.5 W
Luminous efficacy	66.5 lm / W
Fitting	Minude LED 500mA 2700K
Change	964 lm 2700 K 8.5 W
	Emergency lighting factor 1



Luminaire luminous flux	225 lm
Light output ratio	23.3 %
Connected load	8.5 W
Luminous efficacy	26.4 lm / W
Fitting	V6 HD 2700K 500mA
Change	964 lm 2700 K 8.5 W
	Emergency lighting factor 1



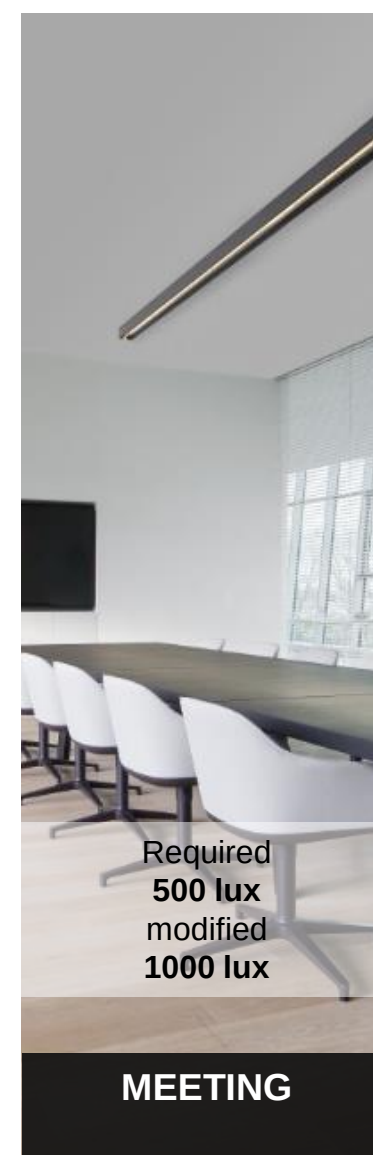
ILLUMINANCE L (lux)

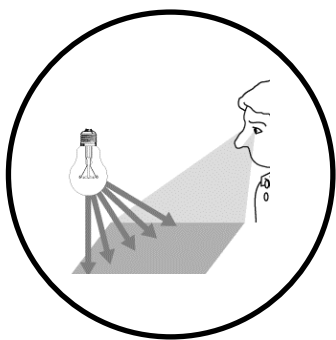
Indicates the amount of lumen that hits a surface

How much luminous flux is spread over a given area.

Illumination of the space enables correct perception of visual information, recognizing objects and faces.







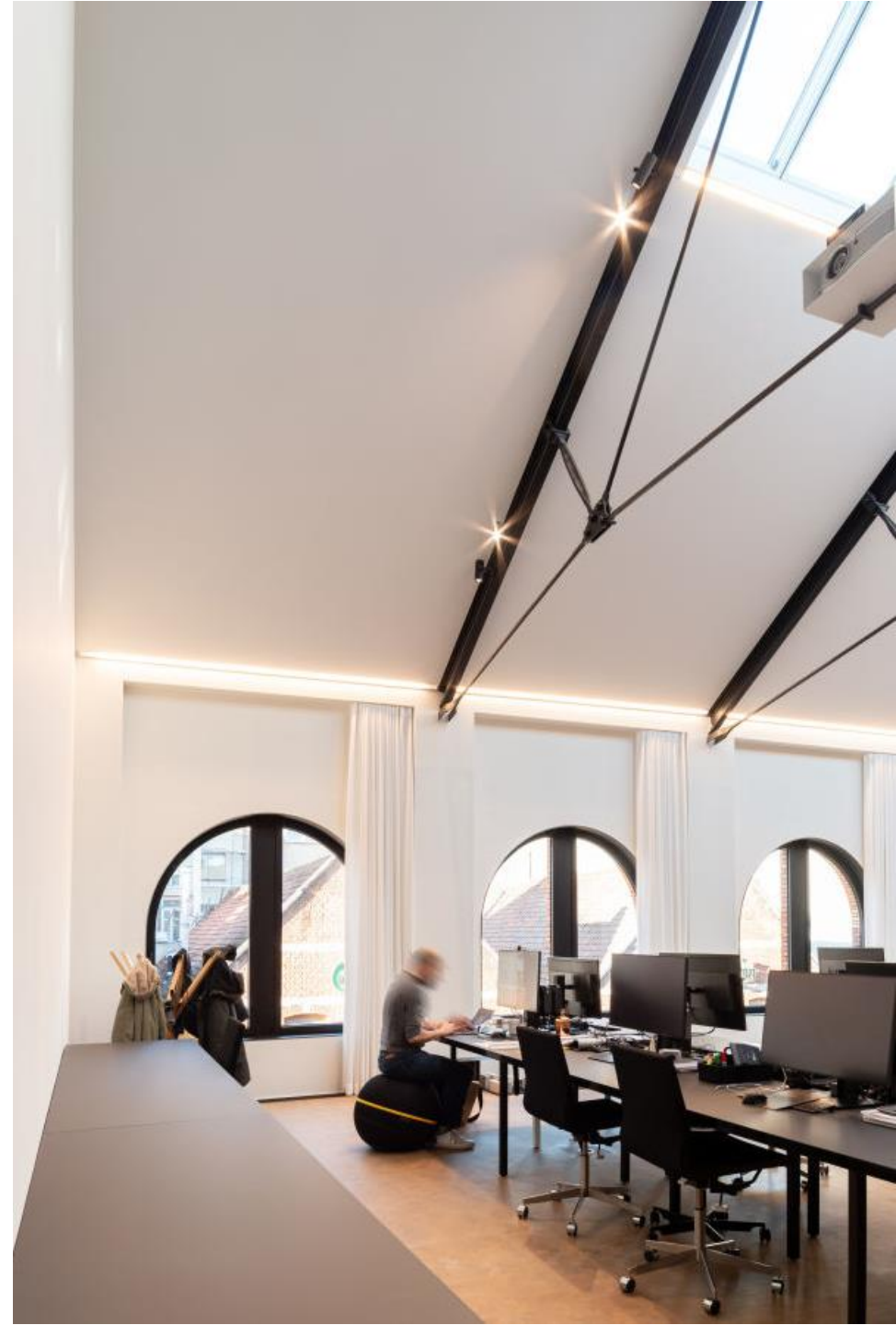
LUMINANCE L (cd/m²)

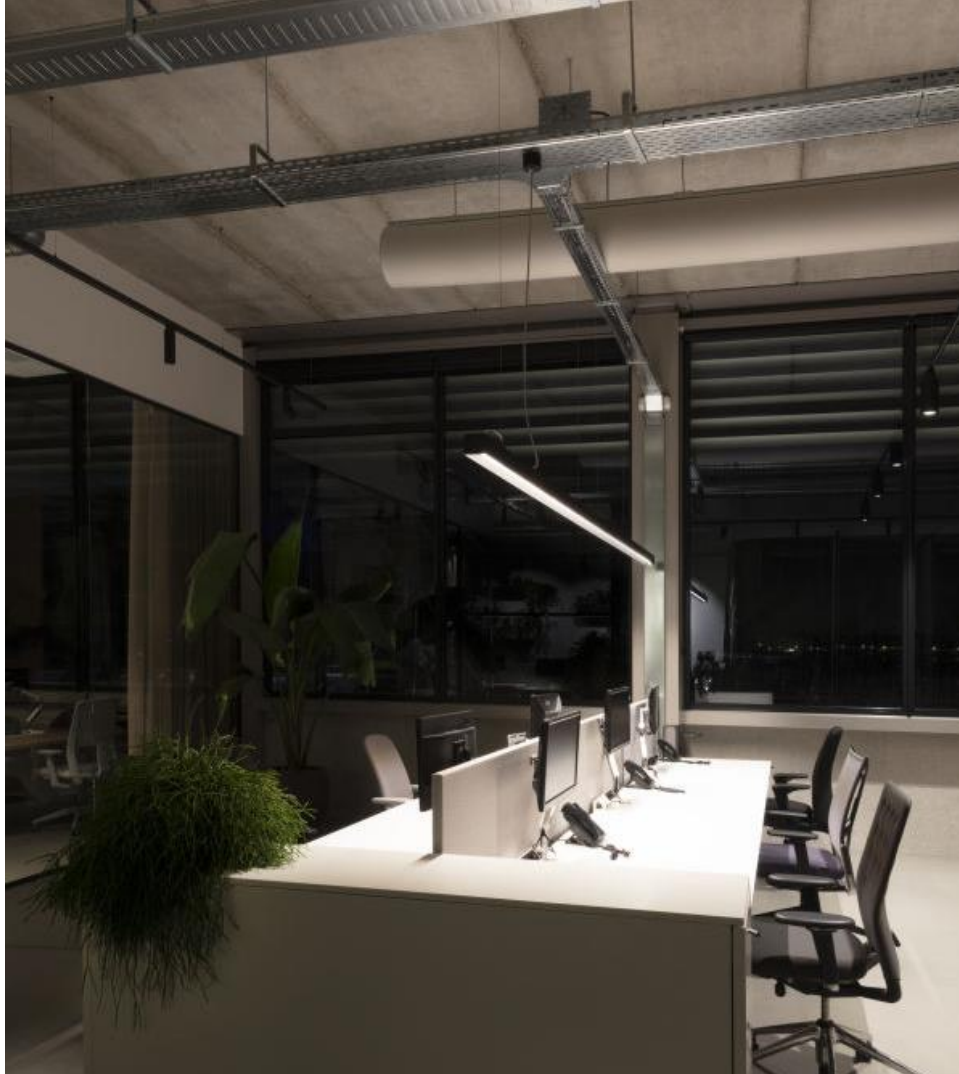
Luminance defines the brightness of an object or lightsource.

Luminance of the sun: 1.600.000.000 cd/m²

Luminance of the moon: 2.500 cd/m²

The luminances of all surfaces shall be taken into consideration when creating a lighting design





Luminance contrast too high

Eyes fatigue

Constant eye adaptation



Luminance contrast too low

Dull room

Non stimulation space

