PHOTOMETRIC TESTING

MAKMAL PENYELIDIKAN ELEKTRIK

BAHAGIAN INOVASI , PENYELIDIKAN DAN PEMBANGUNAN KEJURUTERAAN

PUSAT KECEMERLANGAN KEJURUTERAAN & TEKNOLOGI JKR (CREaTE)

CONTENTS

OBJECTIVE

USAGE OF GONIOPHOTOMETER TO MEASURE LIGHT OUTPUT OF LUMINAIRES/LIGHT SOURCE

What is Light

3.1 Introduction

In lighting design, the Design Engineer (DE) has to ascertain that his design **provides adequate lighting**.

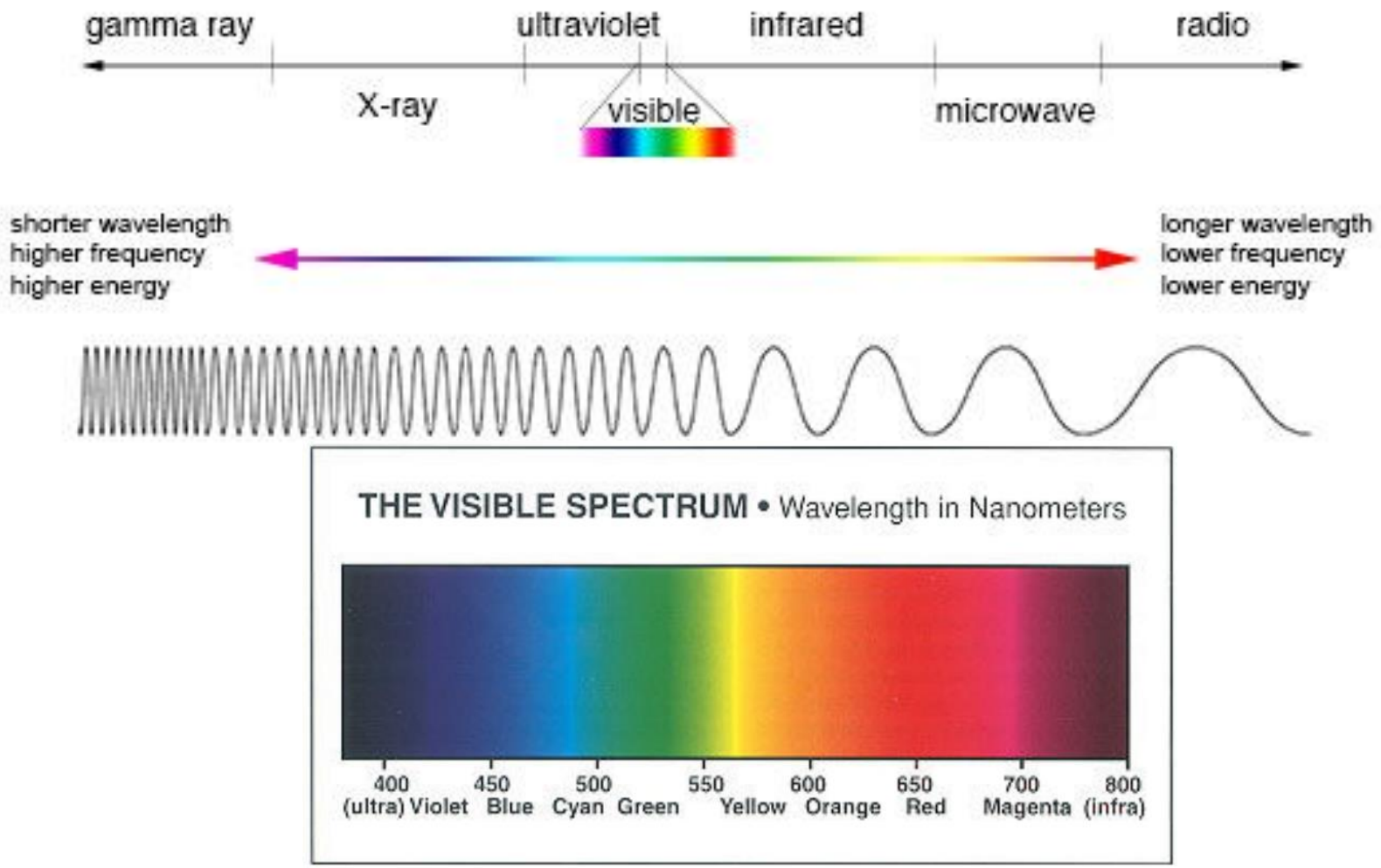
Drawings showing the plan and cross section of each room including the proposed constructional detail of the ceiling and wall, furniture and equipment or machinery layout are required in lighting design. In order to make necessary detailed calculation concerning the type and **quantity of lighting equipment**, additional information on the surface reflectance of walls, ceiling and floors is required. The **level of illumination** obtained must conform to the IES Code or in our case, to JKR Standards.

BASIC THEORY OF LIGHT

- ELECTROMAGNETIC(EM) THEORY
  - Luminous body emit light in the form of radiant energy
  - Radiant Energy is propagated in the form of EM Waves
  - EM Waves act upon the retina , stimulating a response that produces visual sensation

LIGHT : the **electromagnetic radiations** which **create visual sensation** to human eyes are called light

ELECTROMAGNETIC SPECTRUM



UNIT OF MEASUREMENT

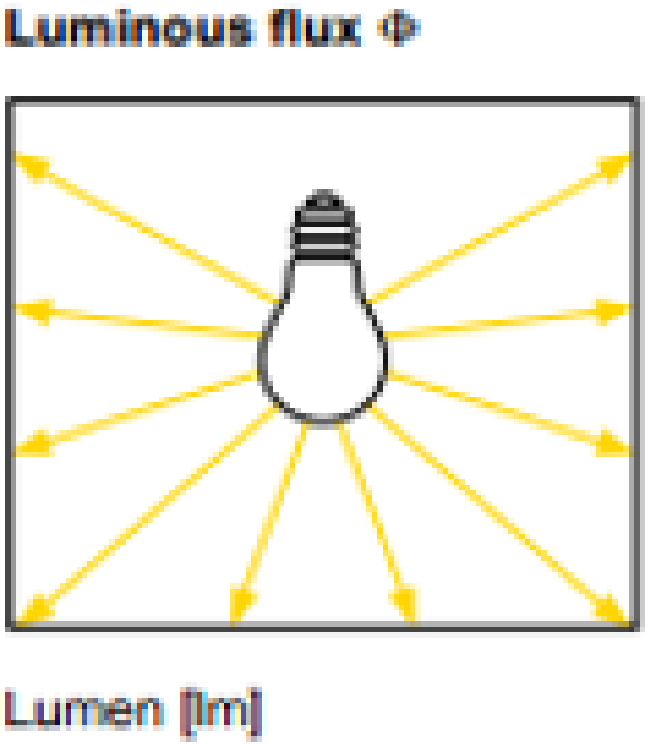
- CANDELA (cd)
  - **SI Unit**
  - **Luminous intensity in a given direction of a source that emits monochromatic radiation of frequency 540 x 10^{12} hz and that has a radiant intensity in the direction of 1/6383 $W.sr^{-1}$**

PHOTOMETRIC TERMS

- **LUMINOUS FLUX**: measured in lumens (lm), is the total amount of light produced by a source without regard to direction. The luminous flux is provided by lamp.

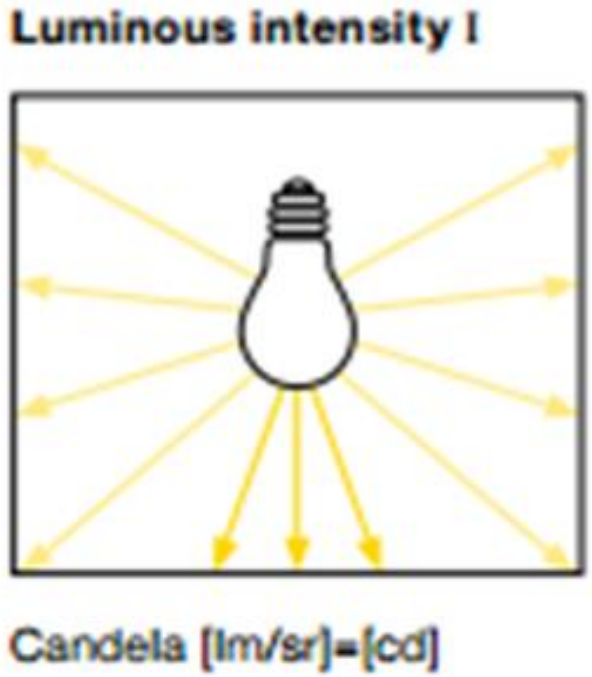
EXAMPLE

T8 FLUORESCENT LAMP: 1320lm



PHOTOMETRIC TERMS

LUMINOUS INTENSITY: measured in candela (cd), is the amount of light produced in a specific direction.

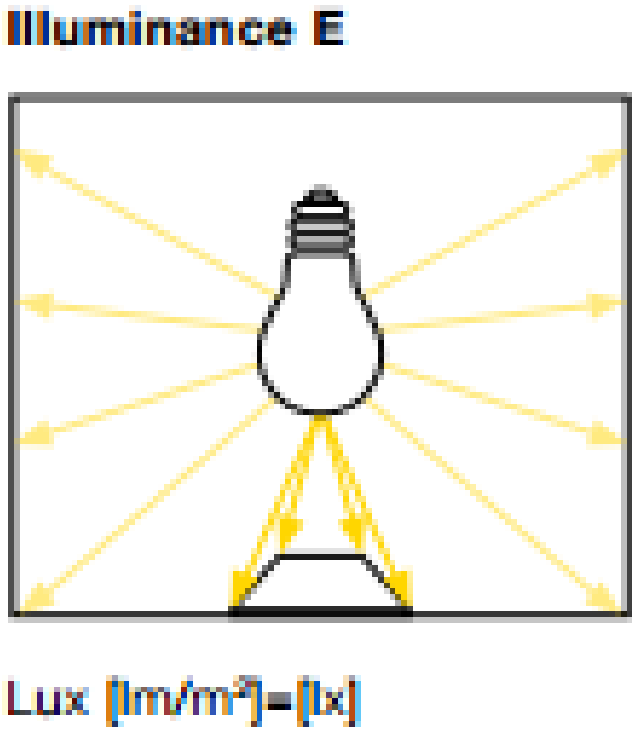


PHOTOMETRIC TERMS

ILLUMINANCE :incedent luminous flux on a differential element of surface located at a point and oriented in a particular direction.

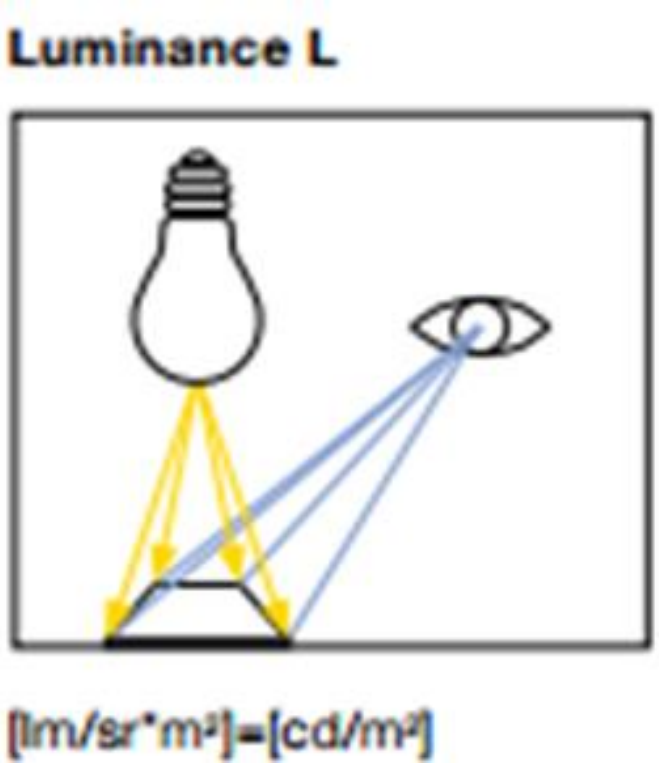
(lumens/Unit Area)

Lux : Lumens /Square Meter

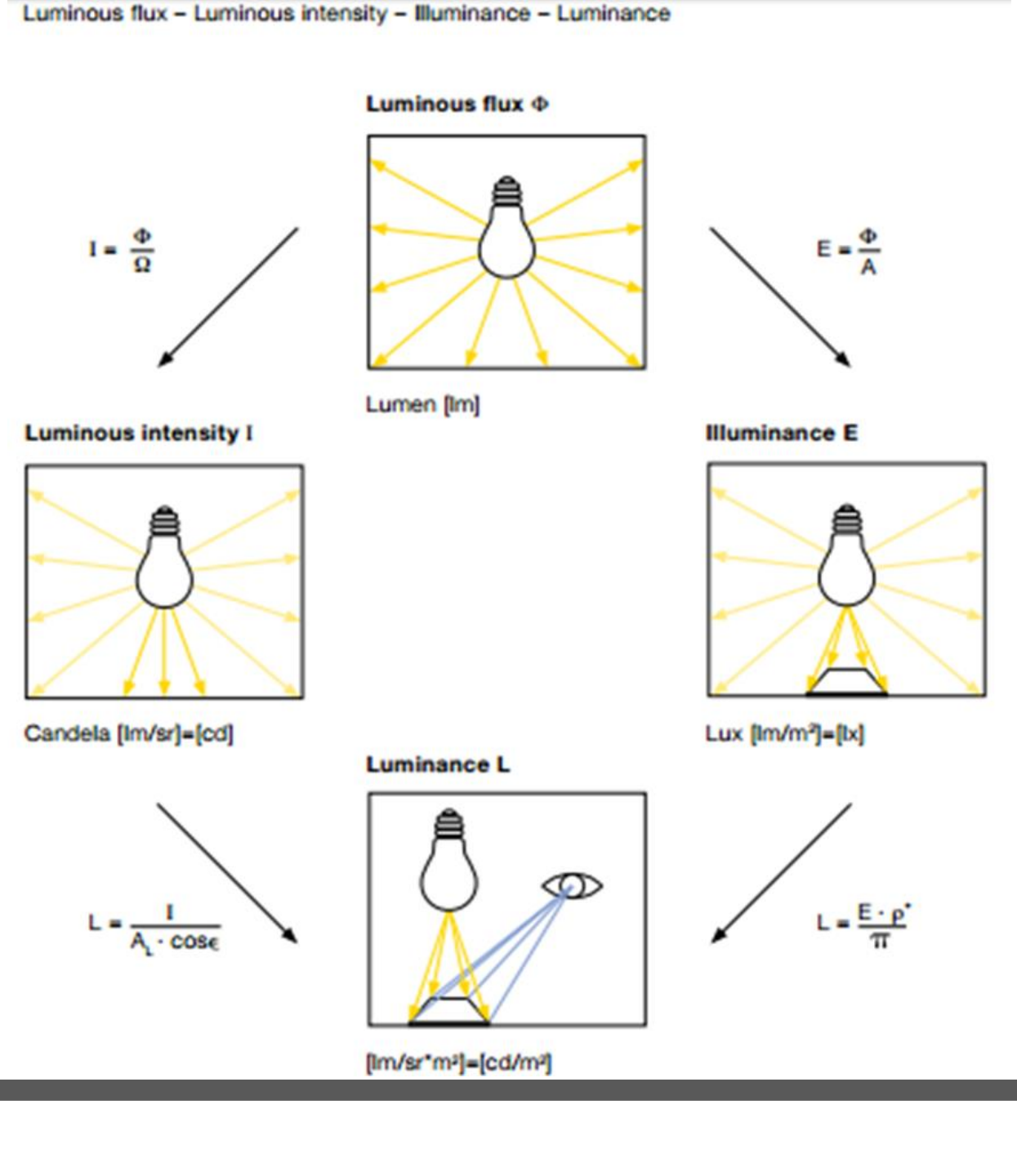


PHOTOMETRIC TERMS

Luminance : Light Emitting power of a surface, in a particular direction per unit apparent area.

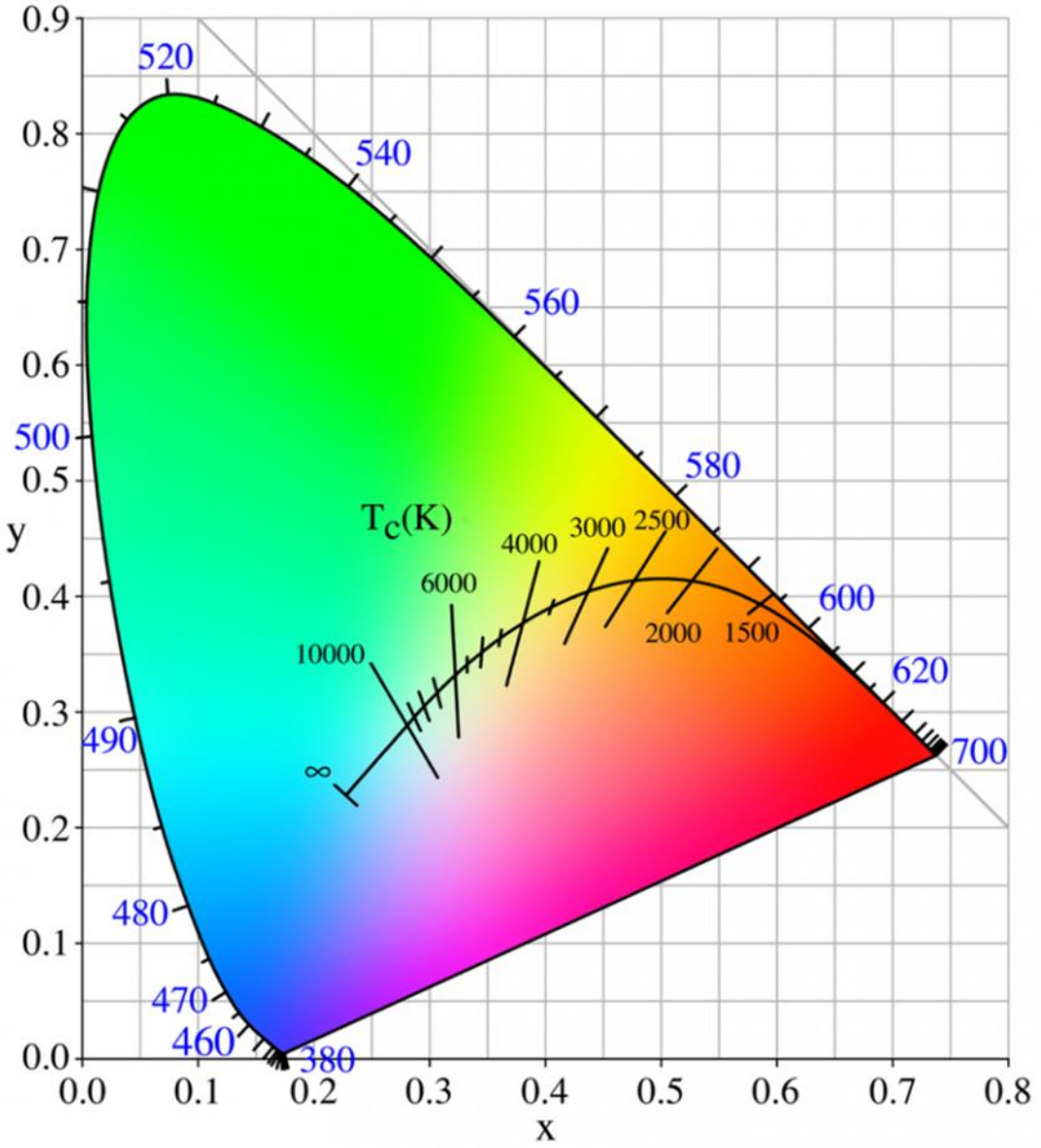


PHOTOMETRIC TERMS

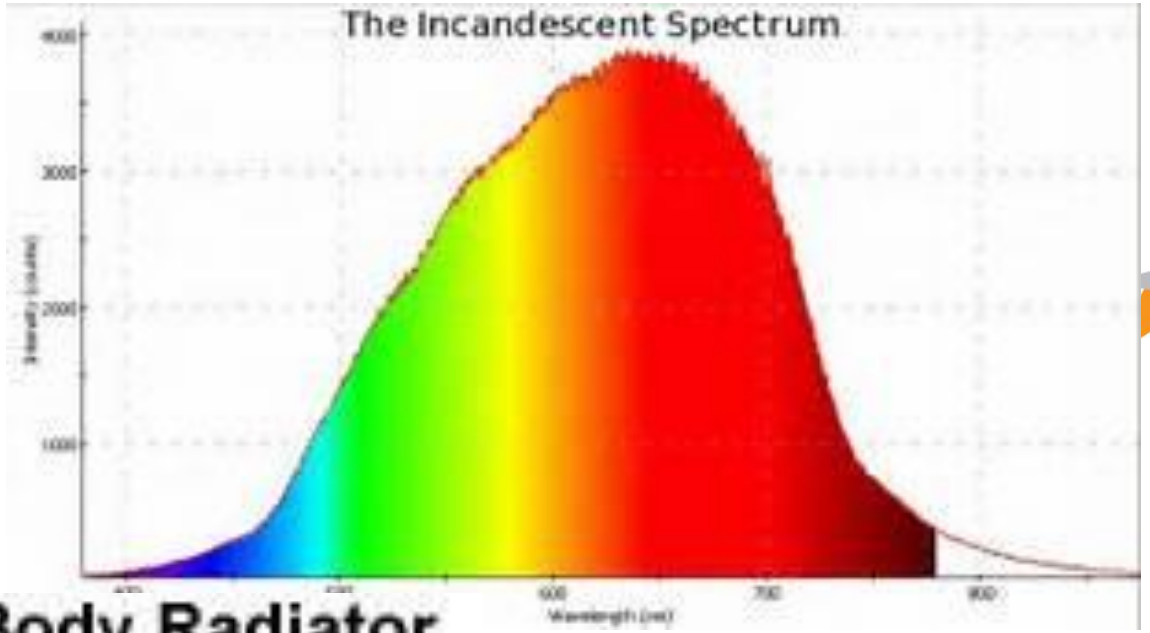


PHOTOMETRIC TERMS

- **COLOUR TEMPERATURE and Correlated Colour Temperature :**
- **COLOUR TEMPERATURE : A Temperature at which a blackbody would have to be operated to produce the same colour (Incandescent Source Only)**
- **Correlated Colour Temperature : Appearance of illumination from a light source that isn't incandescent.**



Light Colour



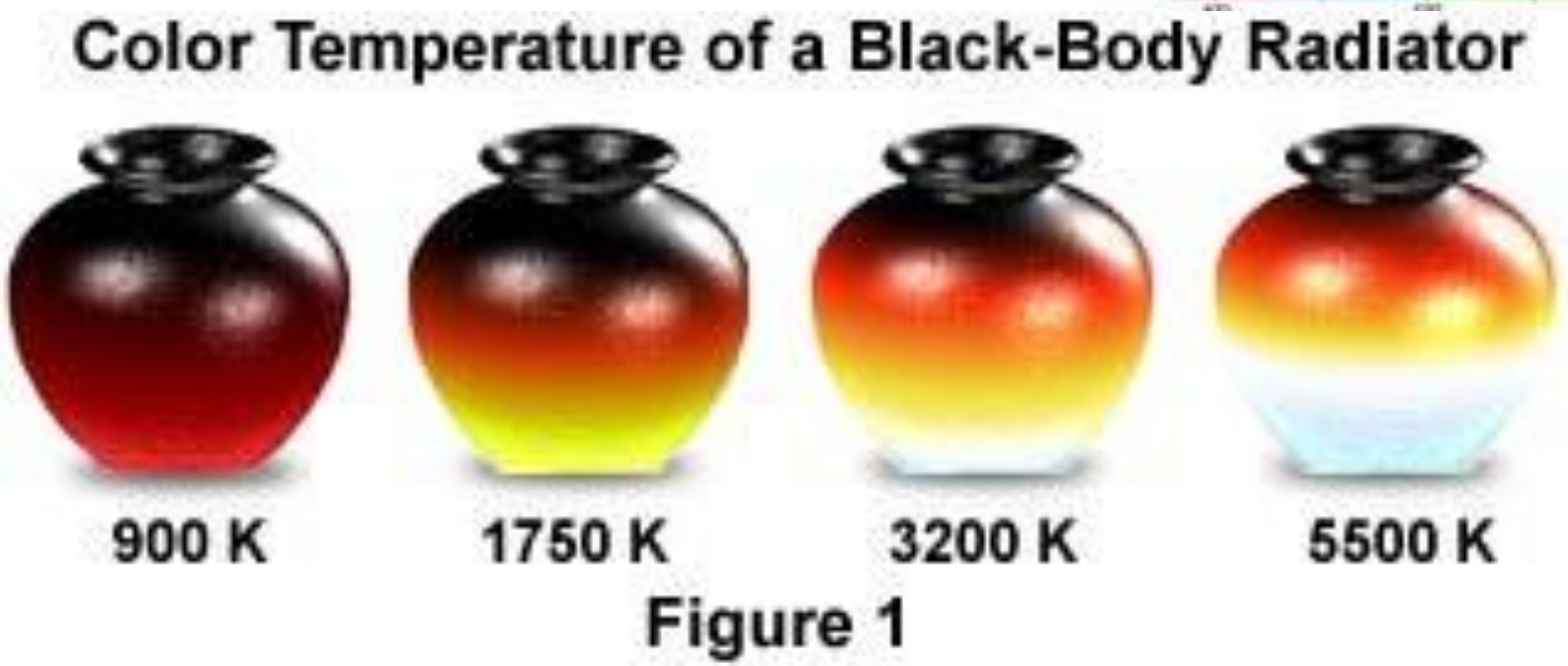
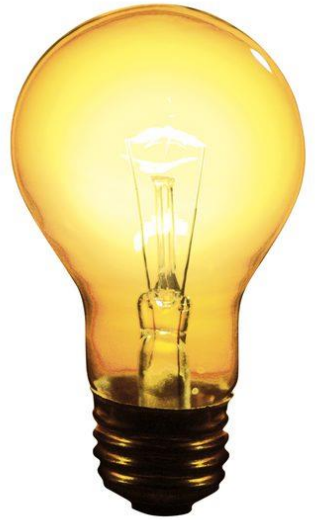


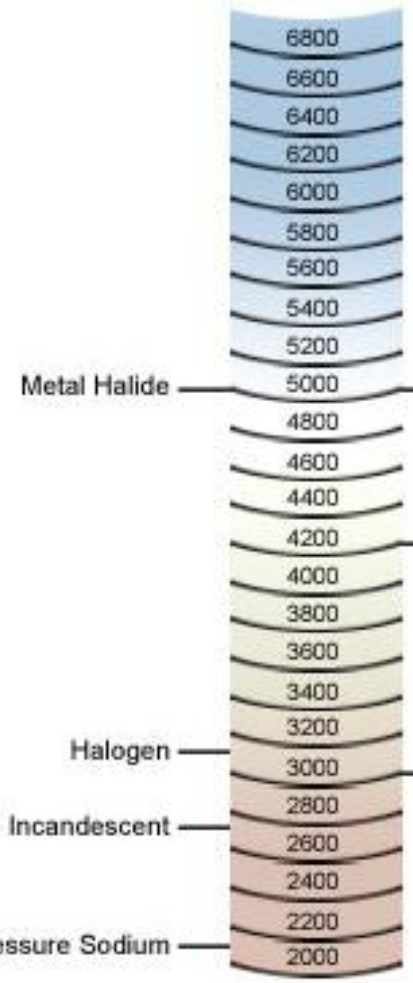
Figure 1

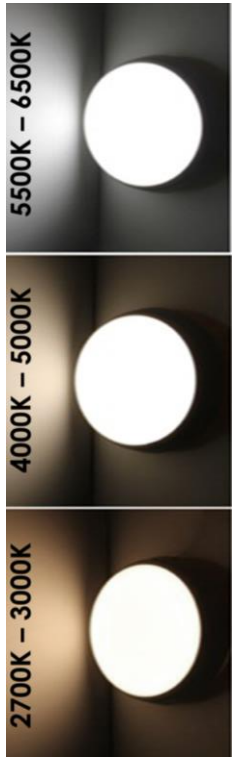


CIE 1931

Light Colour

Correlated Colour temperature





Correlated Colour Temperature

Cold

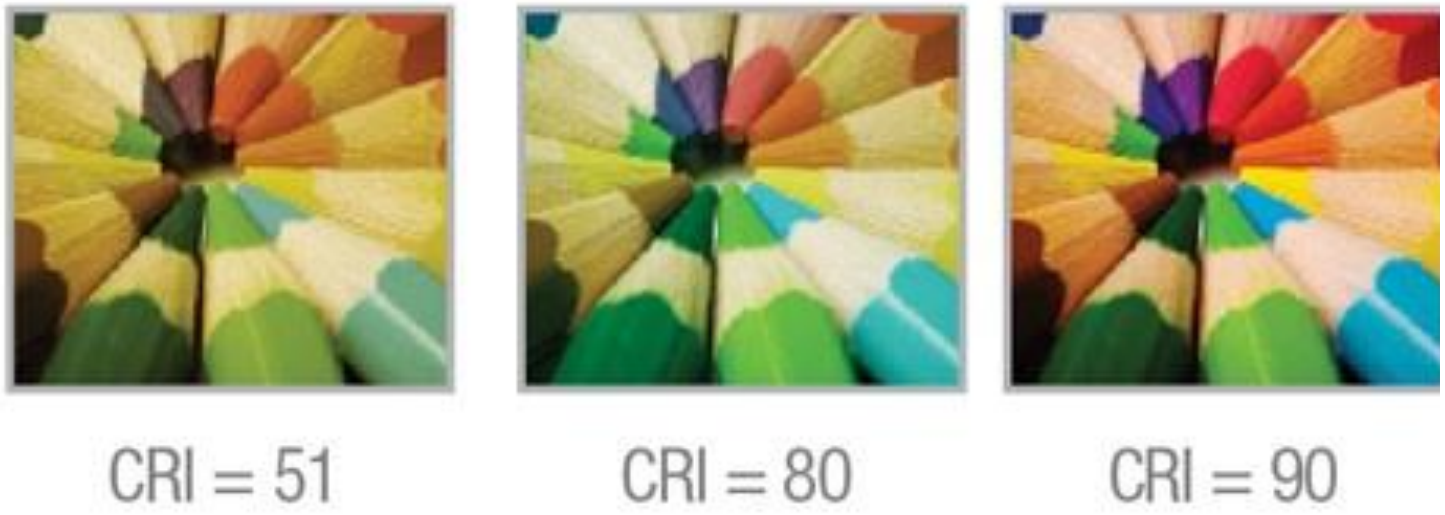
Original

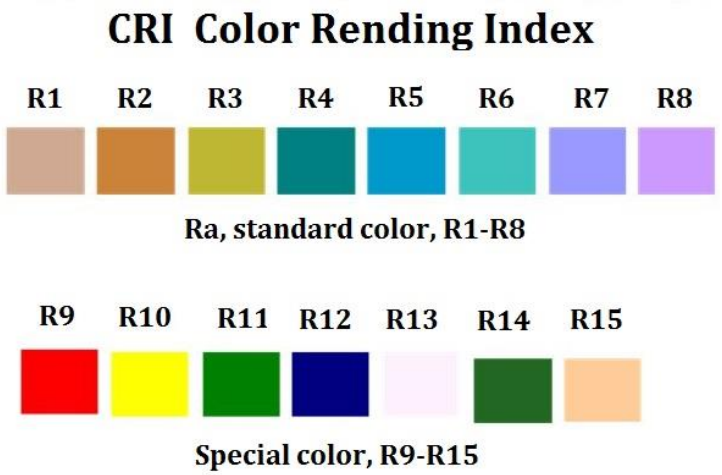
Warm

Correlated Colour Temperature

PHOTOMETRIC TERMS

- **COLOUR RENDERING INDEX:** Quantitative measure of the ability of a light source to reveal the colors of various objects faithfully in comparison with an ideal or natural light source.





- **COLOUR RENDERING INDEX:** Typical values

SOURCE	ACHIEVABLE CRI
Incandescent/Halogen	> 95
T8 Linear Fluorescent	75-85
Cool White Linear Fluorescent	62
Compact Fluorescent	82
Standard Metal Halide	65
Standard HPS	22
LED	80-98

CRI	RATING
> 90	Great
80-90	Very Good
70-80	Good
60-70	Good
40-60	Poor

- **COLOUR RENDERING INDEX:** Typical values

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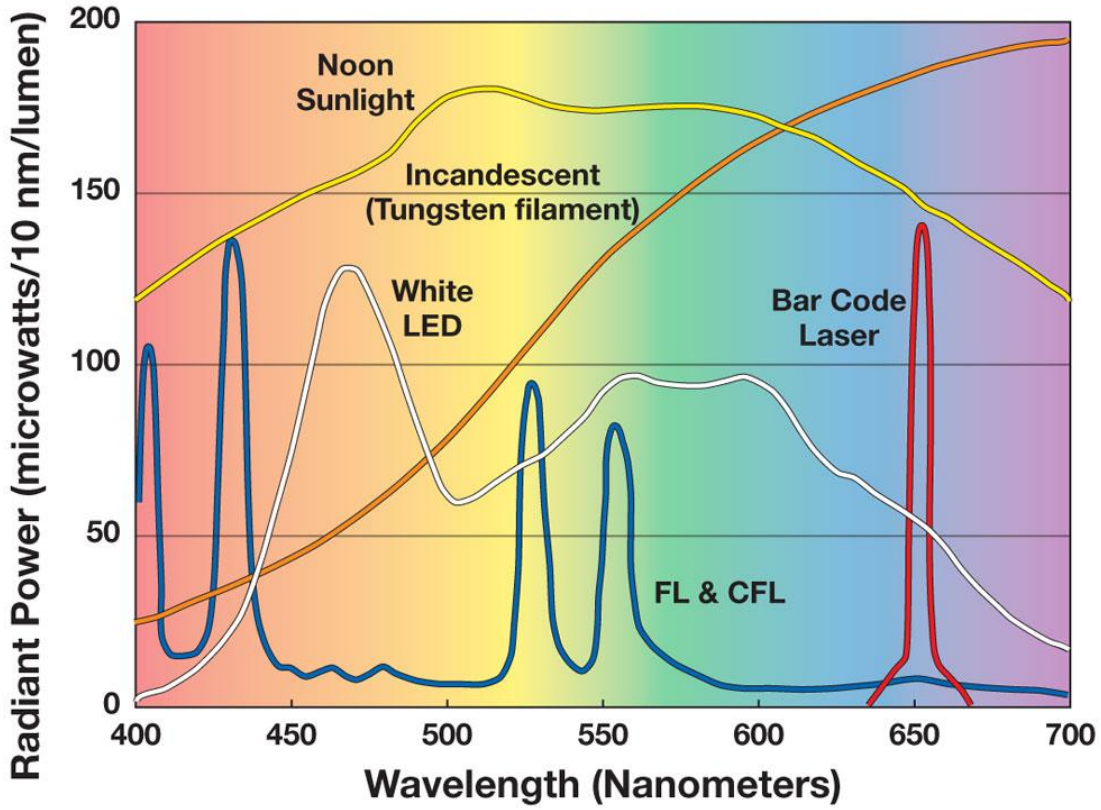
60-70	Good
40-60	Poor

PHOTOMETRIC TERMS

- **SPECTRAL POWER DISTRIBUTION :**the radiant power emitted by the source at each wavelength or band of wavelengths over the visible region (380 to 760 nm).



PHOTOMETRIC TERMS

LUMINOUS EFFICACY : Luminous Flux/Watt (lm/W)

EFFICACY ≠EFFICIENCY

$$Efficiency = \frac{Output}{Input}\ \%$$

ENERGY (WATT)

ENERGY (WATT)

$$EFFICACY = \frac{Output}{Input}$$

BRIGHTNESS (LUMEN)

ENERGY (WATT)

PHOTOMETRIC TERMS

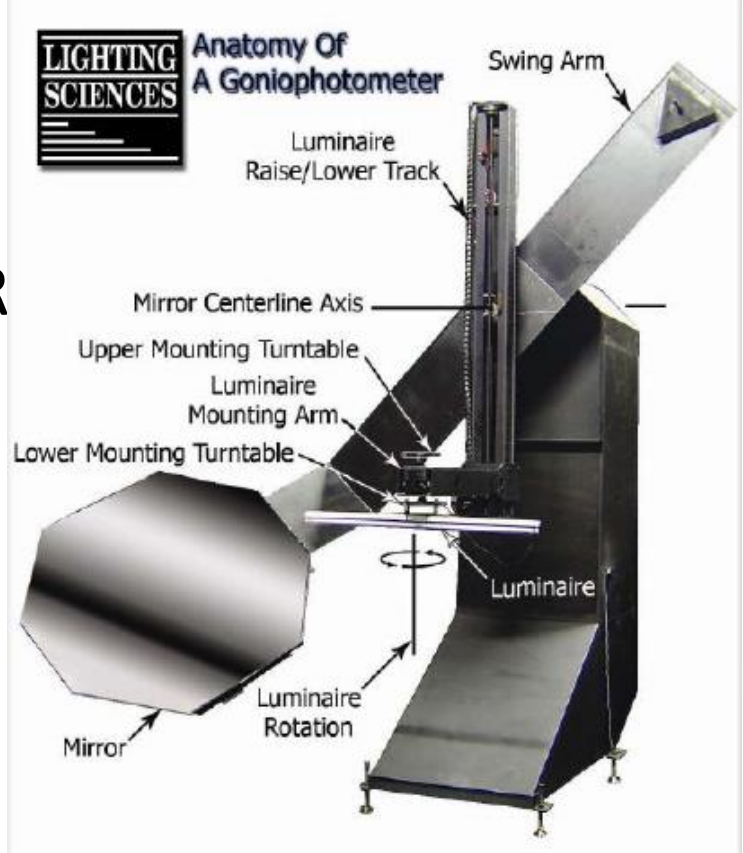
LUMINOUS EFFICACY (lm/W)

GONIOPHOTOMETER

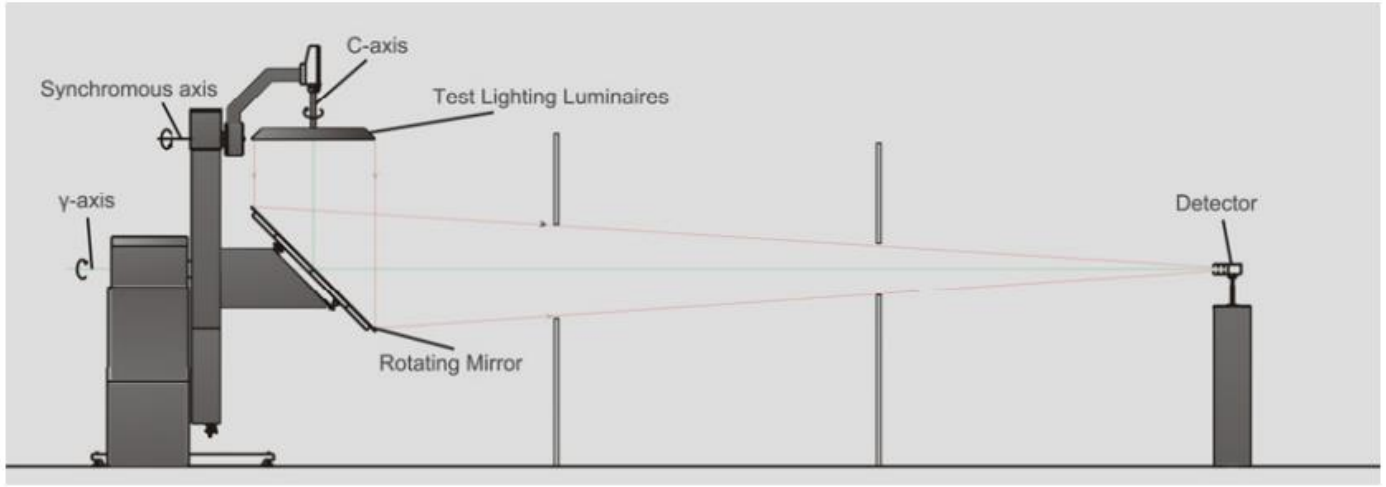
- **GONIOPHOTOMETER** is a device used for measurement of the **light** emitted from an object at **different angles**.

TYPES OF GONIOPHOTOMETER

- MOVING MIRROR GONIOPHOTOMETER
- MOVING DETECTOR GONIOPHOTOMETER
- MOVING LUMINAIRE GONIOPHOTOMETER



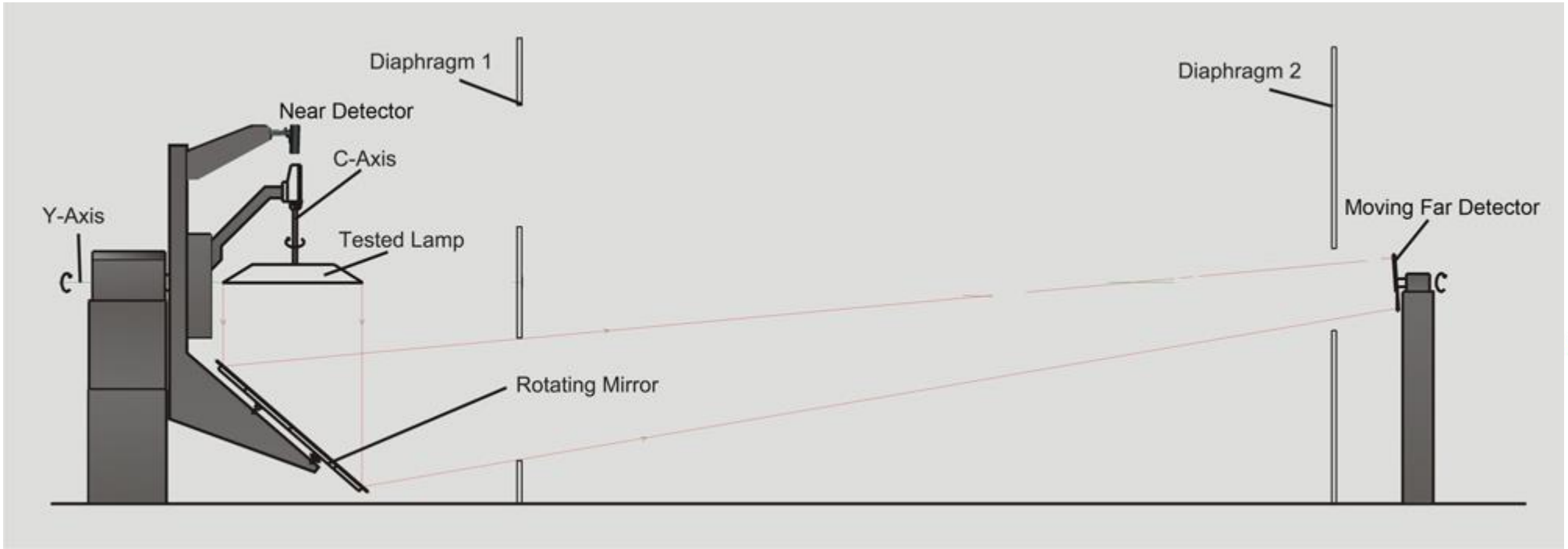
MOVING MIRROR GONIOPHOTETER



Measurement Principle

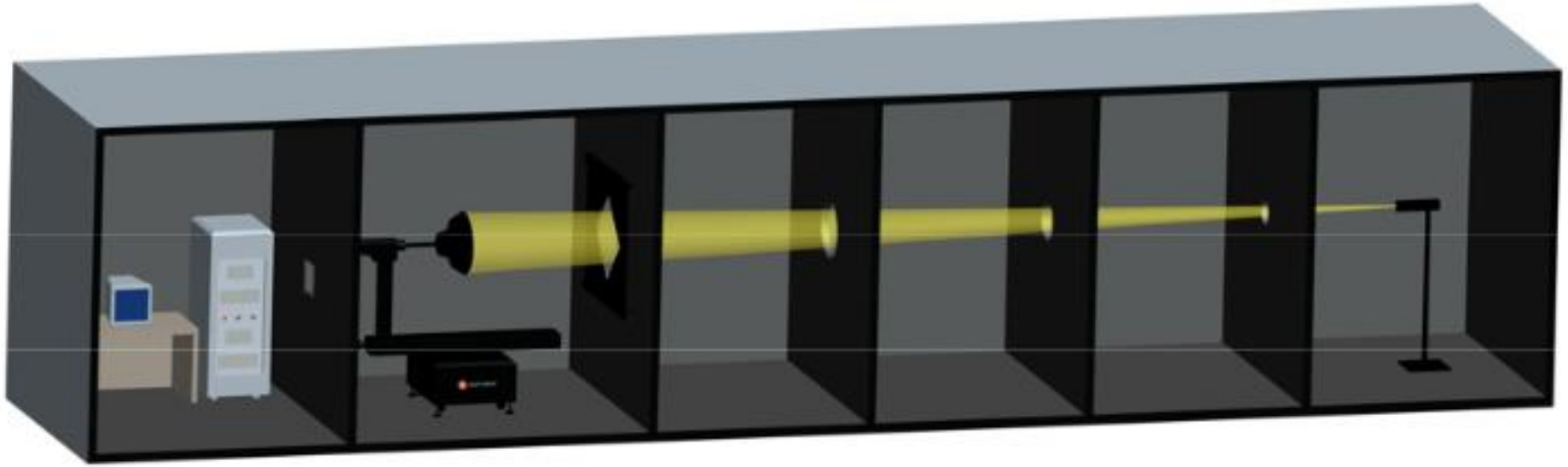
- Detector is fixed
- Luminaire turns around the vertical axis only
- Mirror moves around luminaire
- Polarisation sensitive
- Very large and expensive systems

MOVING DETECTOR GONIOPHOTOMETER

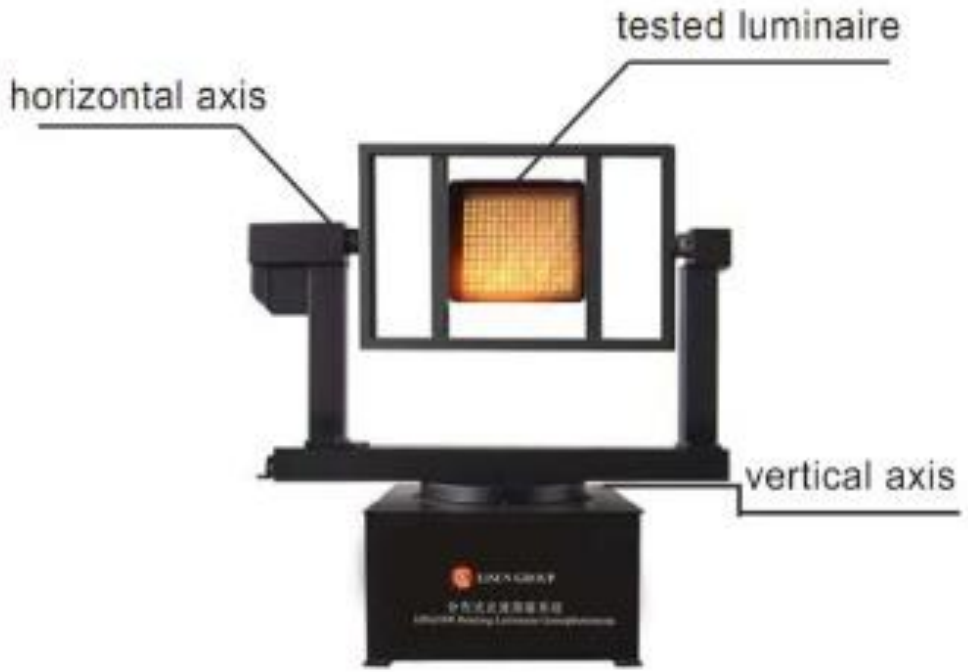


MOVING LUMINAIRE GONIOPHOTOMETER

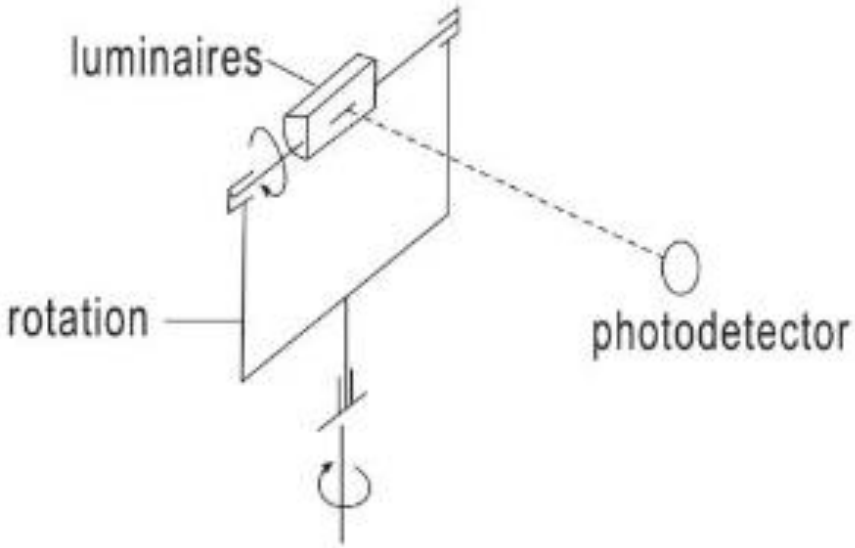
- FIXED DETECTOR
- LUMINAIRE IS ROTATED ABOUT AXIS



MOVING LUMINAIRE GONIOPHOTOMETER



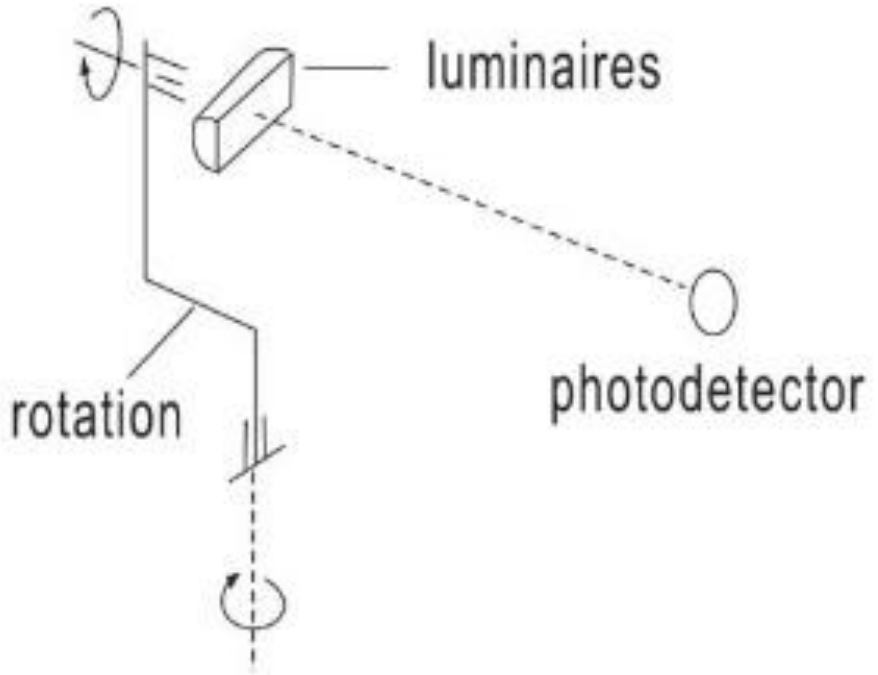
B- BETA



Double pillars structure

MOVING LUMINAIRE GONIOPHOTOMETER

C GAMMA



PHOTOMETRIC MEASUREMENTS

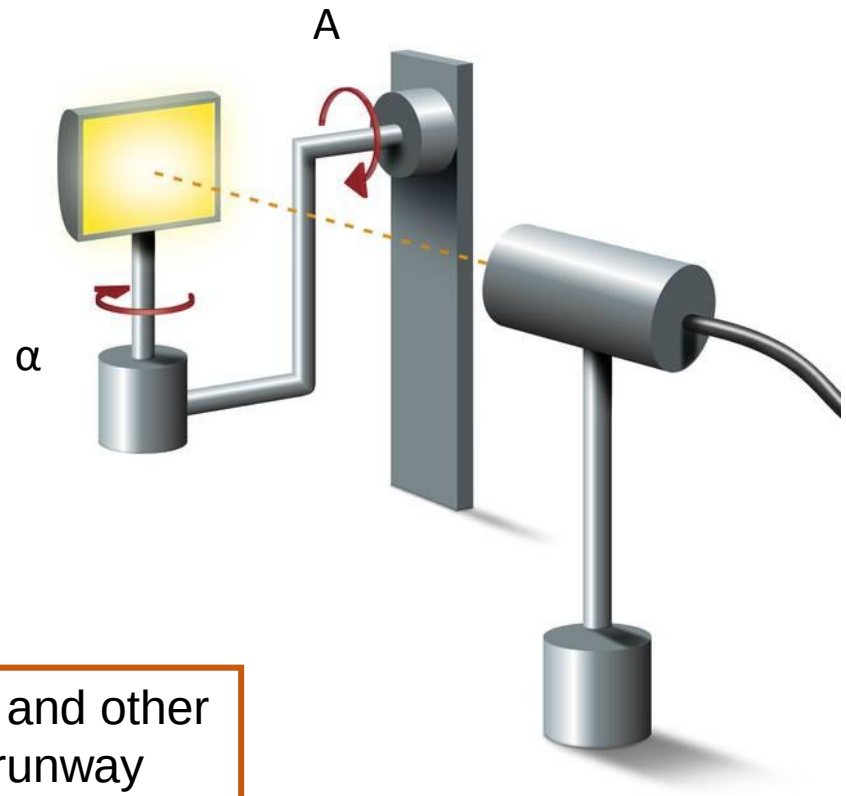
- TYPES OF MEASUREMENT

1. TYPE A (A-ALPHA)
2. TYPE B (B– BETA)
3. TYPE C (C-GAMMA)

PHOTOMETRIC MEASUREMENTS

Type A goniophotometer:

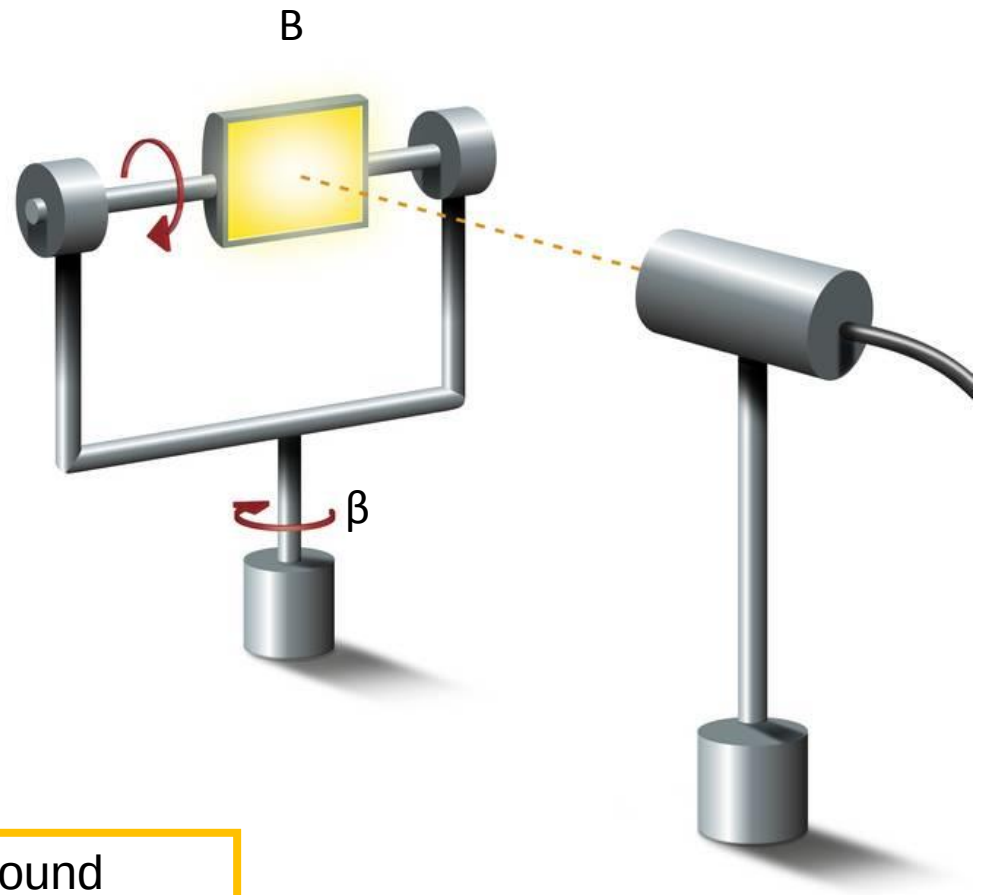
Fixed horizontal axis and moving axis perpendicular to this axis. The measurements are performed by rotating the light source about the horizontal axis, while the other axis is maintained in a fixed position (rotation versus elevation).



usually deployed for automotive exterior lighting and other directed light sources (variable message signs, runway and taxiway lighting, etc.)

PHOTOMETRIC MEASUREMENTS

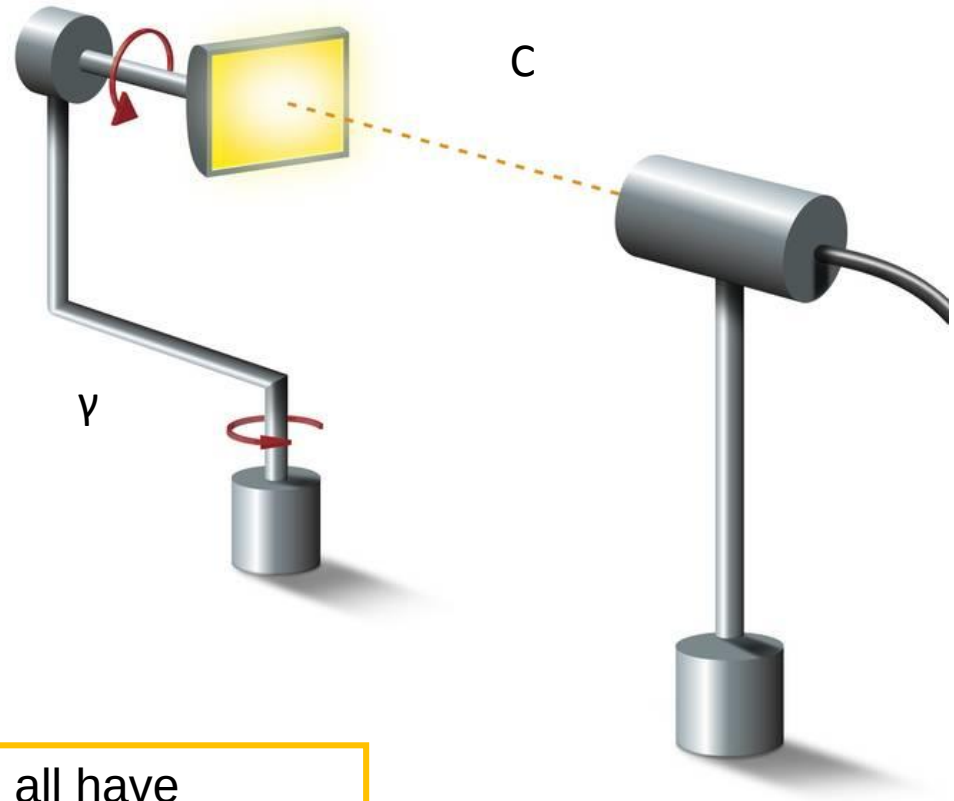
Type B goniophotometer:
Fixed vertical axis and moving horizontal axis. The measurements are performed by rotating the light source about the vertical axis, while the other axis is maintained in a fixed position (elevation versus rotation)



appropriate for street, floodlight and recessed ground luminaires

PHOTOMETRIC MEASUREMENTS

Type C goniophotometer:
Fixed vertical axis, moving horizontal axis. Measurements are performed in the C-plane or on conical surfaces. Type C corresponds to type B, if the light source is rotated by 90°.



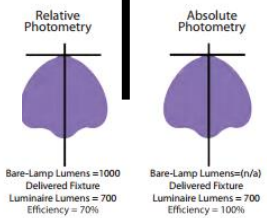
used for products in general lighting which all have asymmetrical light distribution.

RELATIVE VS ABSOLUTE PHOTOMETRY

RELATIVE PHOTOMETRY

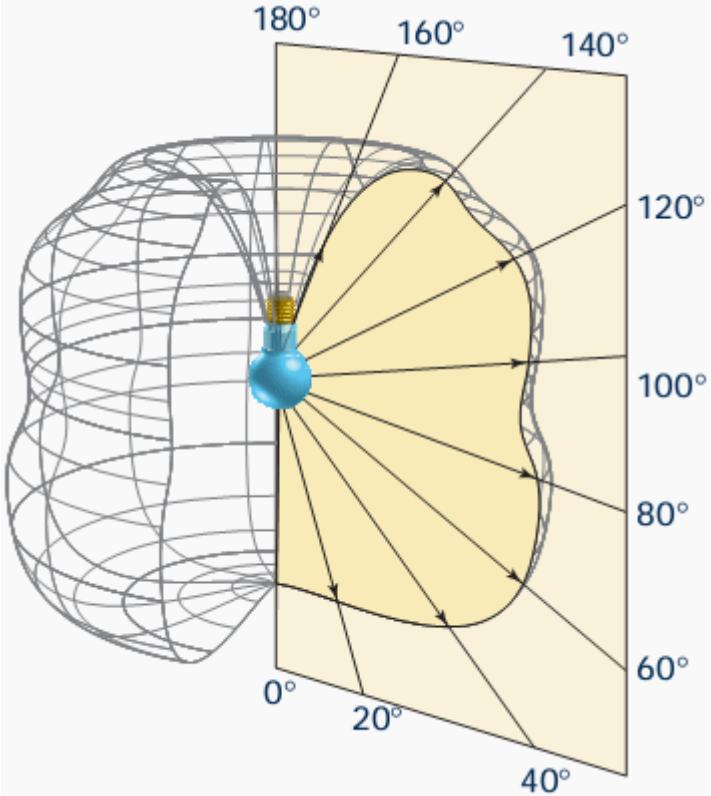
LUMEN = 1000

LOR = 70 %

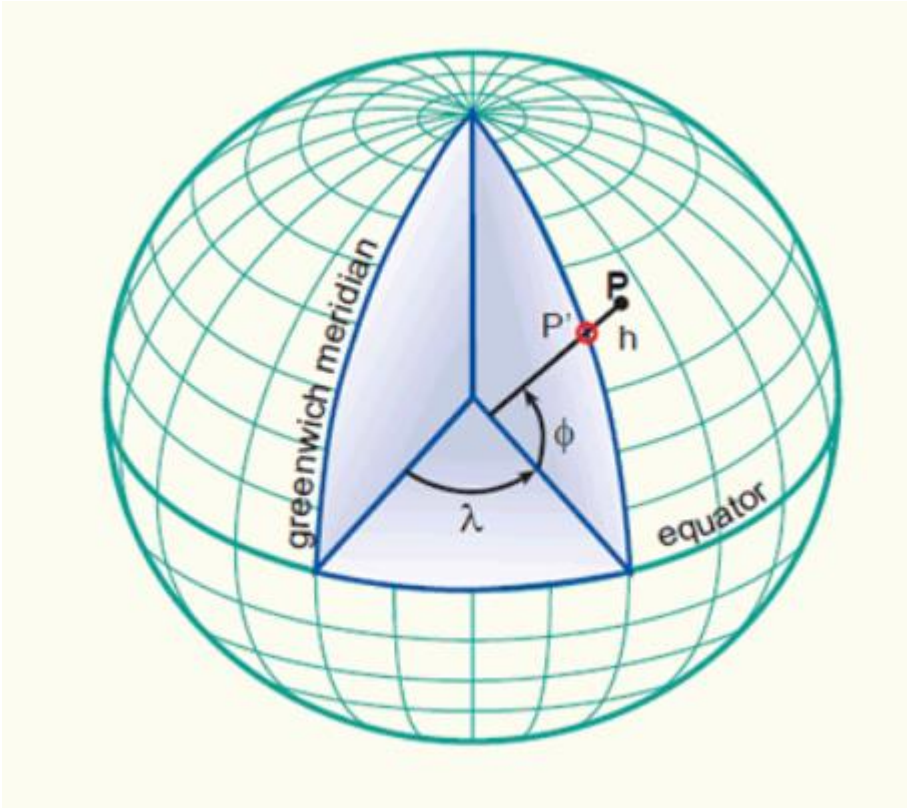


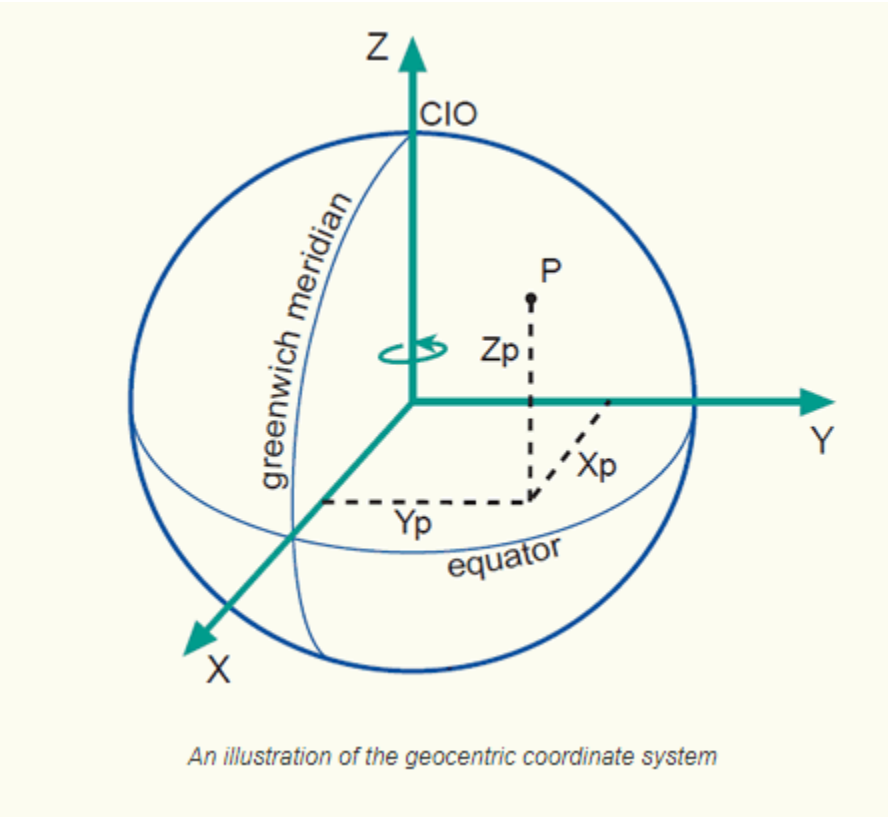
ABSOLUTE PHOTOMETRY

LUMINOUS INTENSITY DISTRIBUTION CURVE



COORDINATE SYSTEM





An illustration of the geocentric coordinate system

PHOTOMETRIC PLACE CIE 140

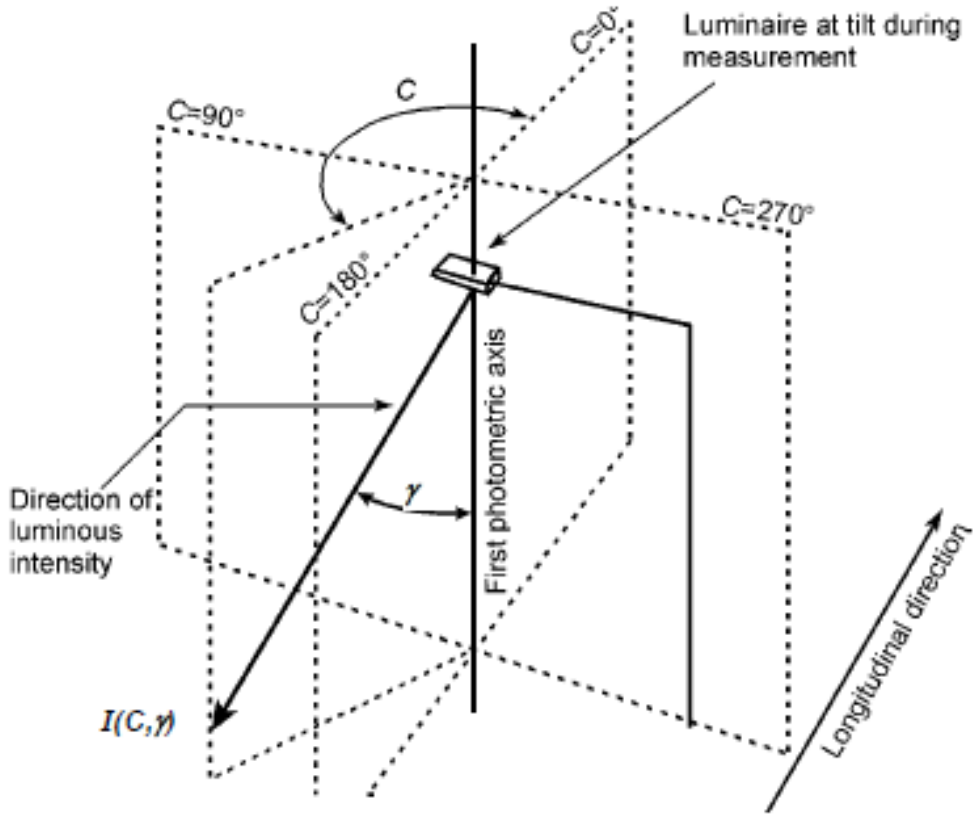
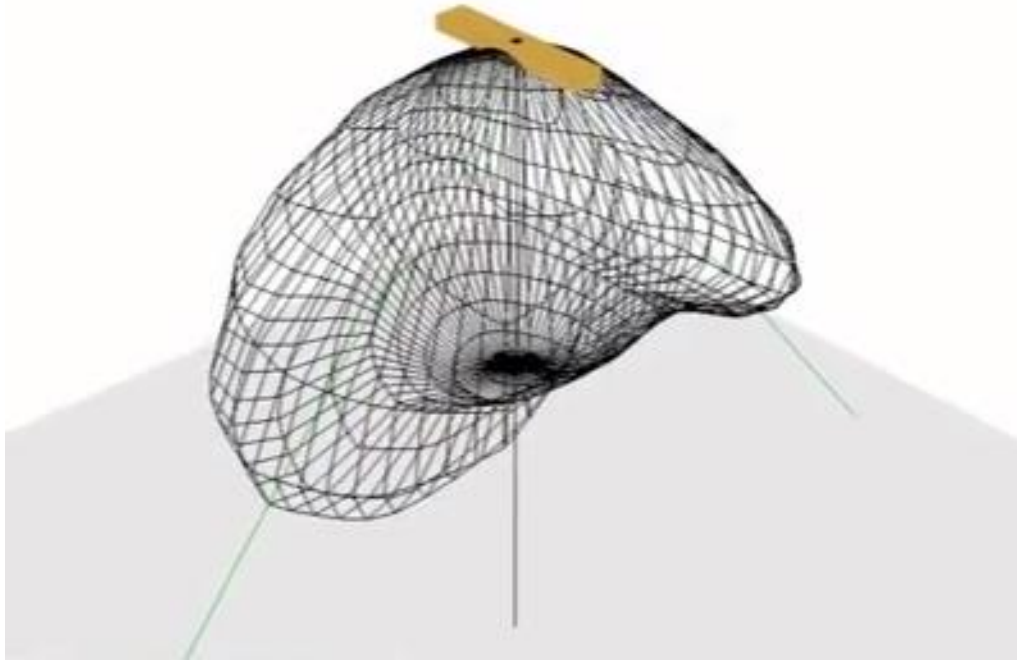


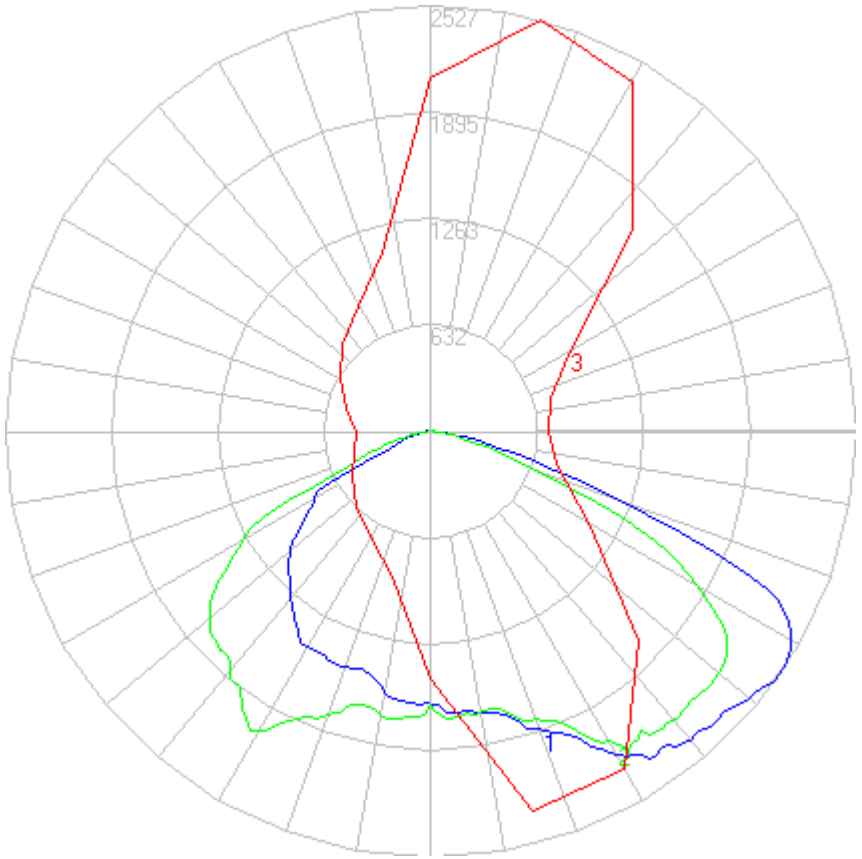
Fig. 1. C,γ coordinate system.

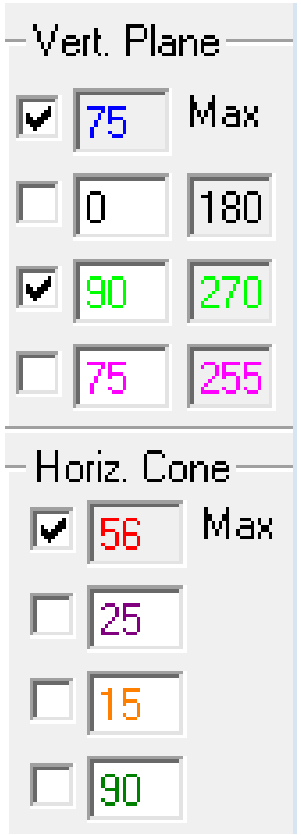
LUMINOUS INTENSITY DISTRIBUTION CURVE



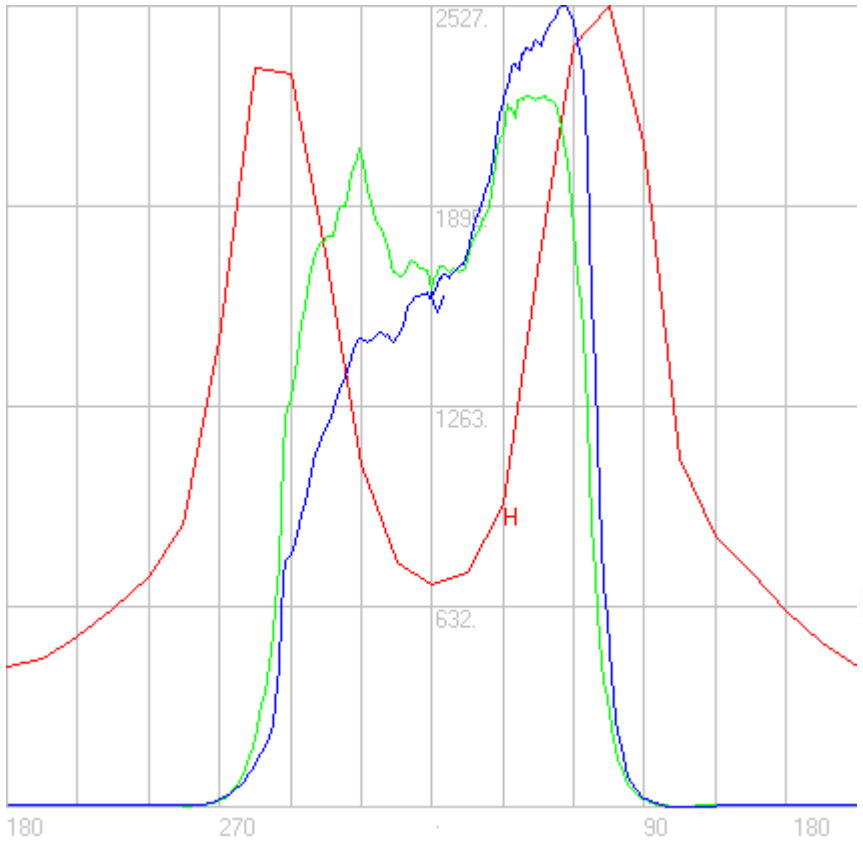
LUMINOUS INTENSITY DISTRIBUTION CURVE

POLAR DIAGRAM

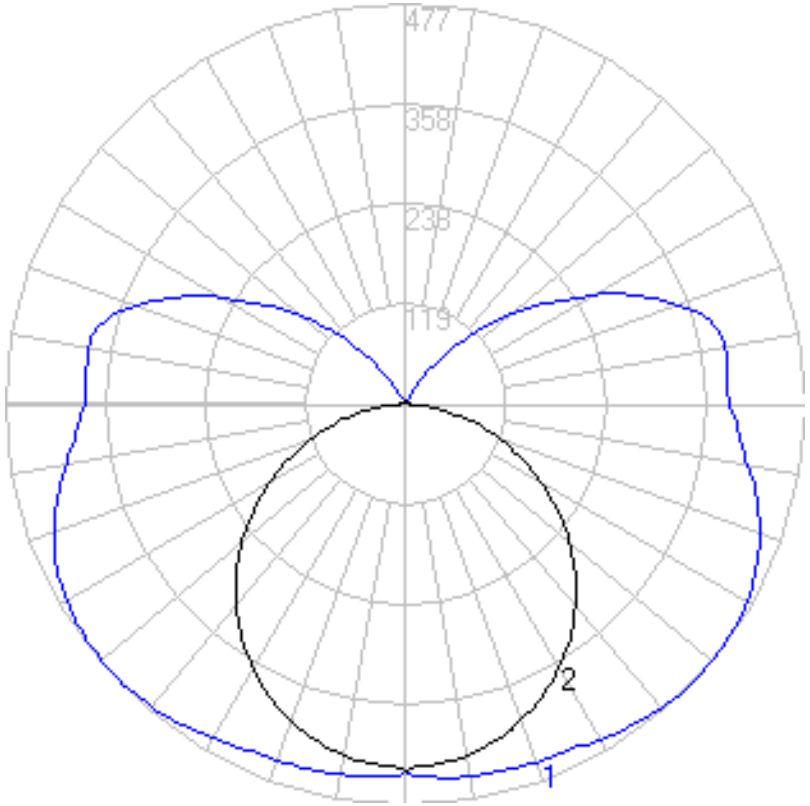




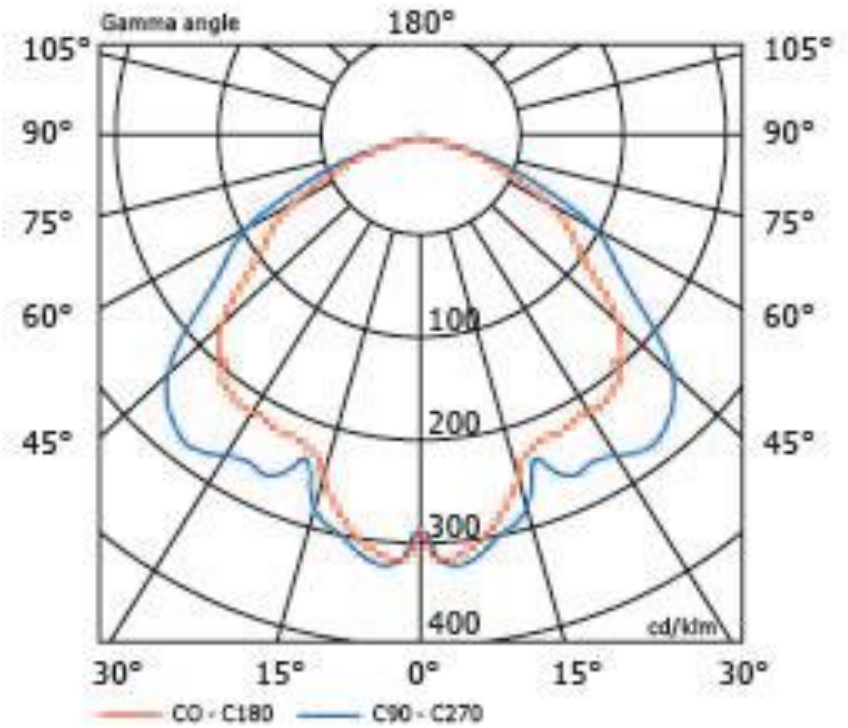
CARTESIAN DIAGRAM



TYPES OF LIGHT DISTRIBUTION

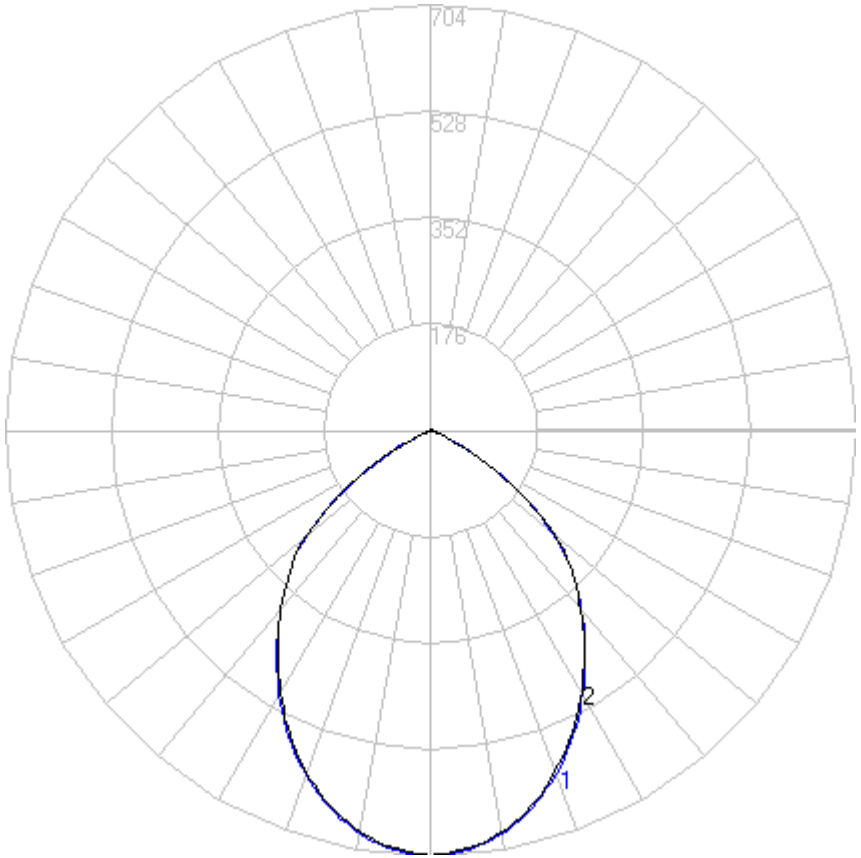


36W T8 BARE CHANNEL

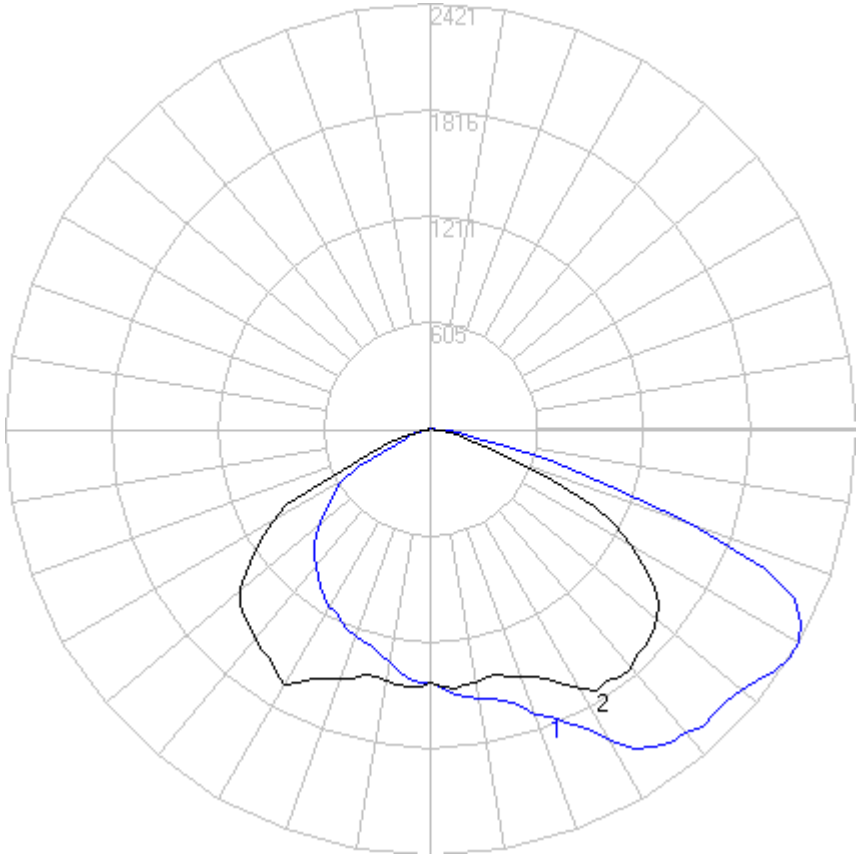


FLOODLIGHT

TYPES OF LIGHT DISTRIBUTION

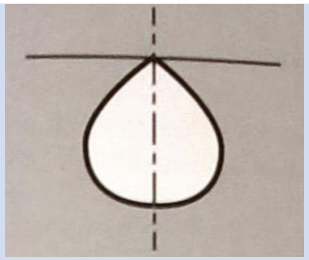
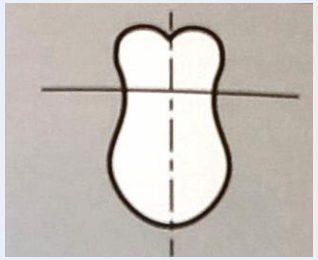
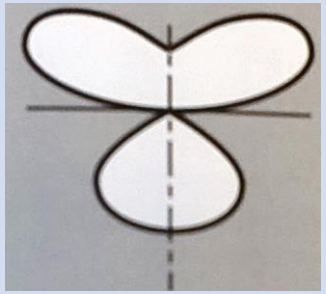


LED DOWNLIGHT

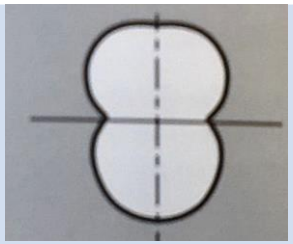
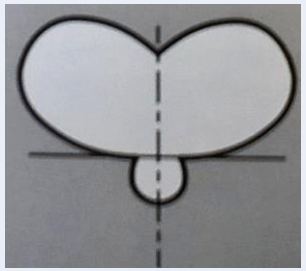
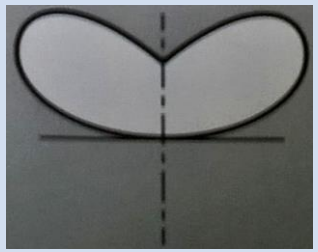


STREET LIGHT

LUMINAIRE DISTRIBUTION – CIE SYSTEM

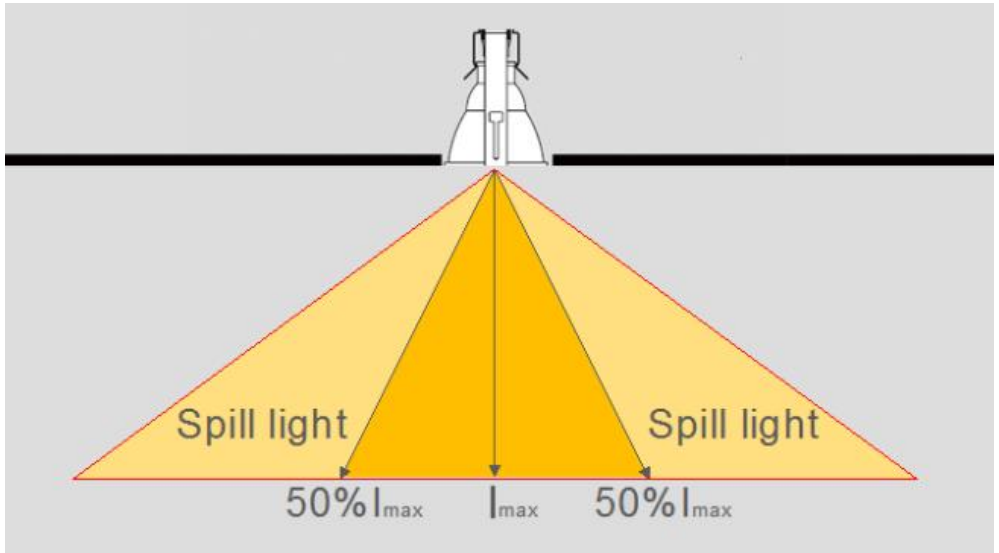
CIE CLASSIFICATION	UPWARD %		DOWNWARD %
DIRECT	0-10		100-90
SEMI-DIRECT	10-40		90-60
DIRECT-INDIRECT	50		50

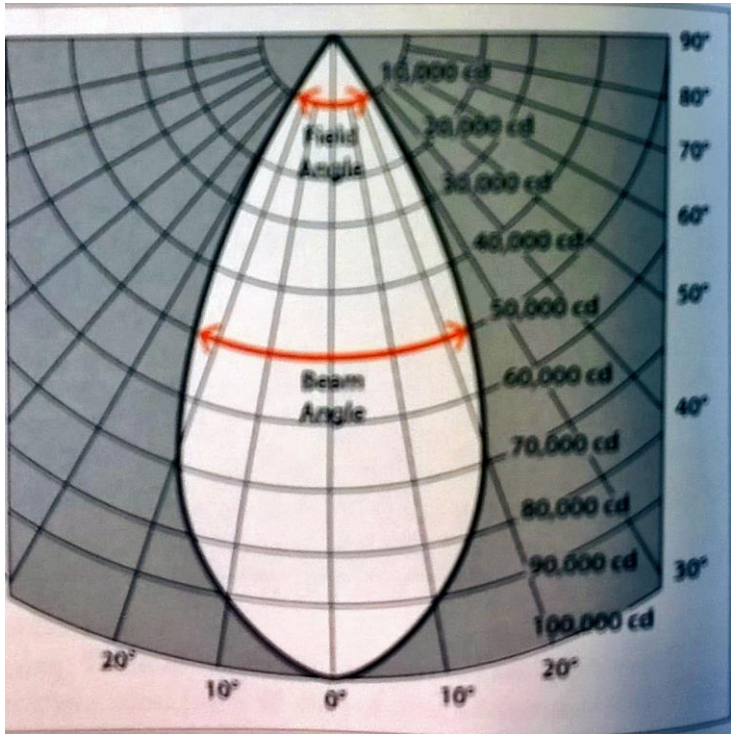
LUMINAIRE DISTRIBUTION – CIE SYSTEM

CIE CLASSIFICATION	UPWARD %		DOWNWARD %
GENERAL DIFFUSE	40-60		60-40
SEMI-INDIRECT	60-90		40-10
INDIRECT	90-100		10-0

MEASUREMENT TERMS

- **FIELD ANGLE :10% of Maximum intensity**
- **BEAM ANGLE /BEAM SPREAD:** Lamp beam spread to 50% intensity



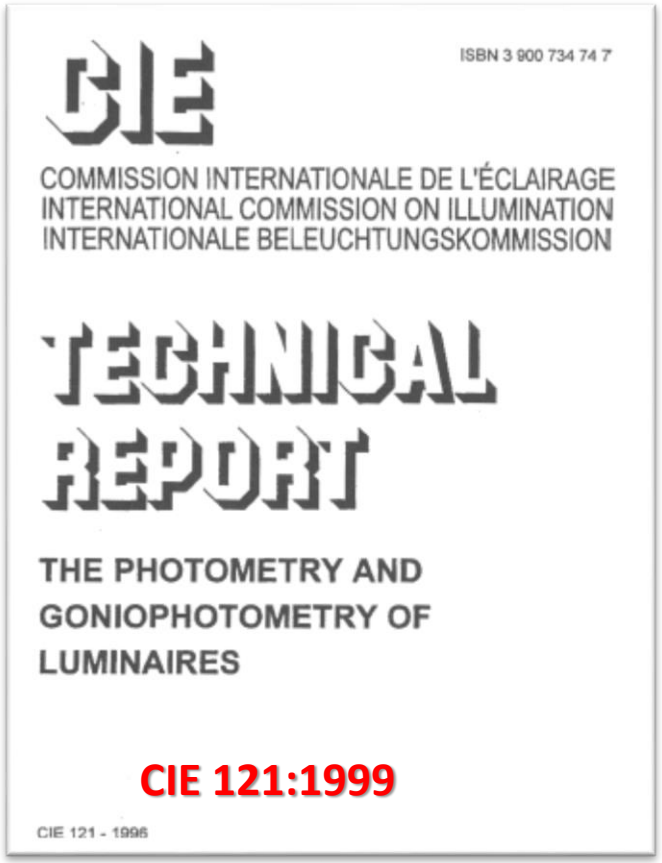


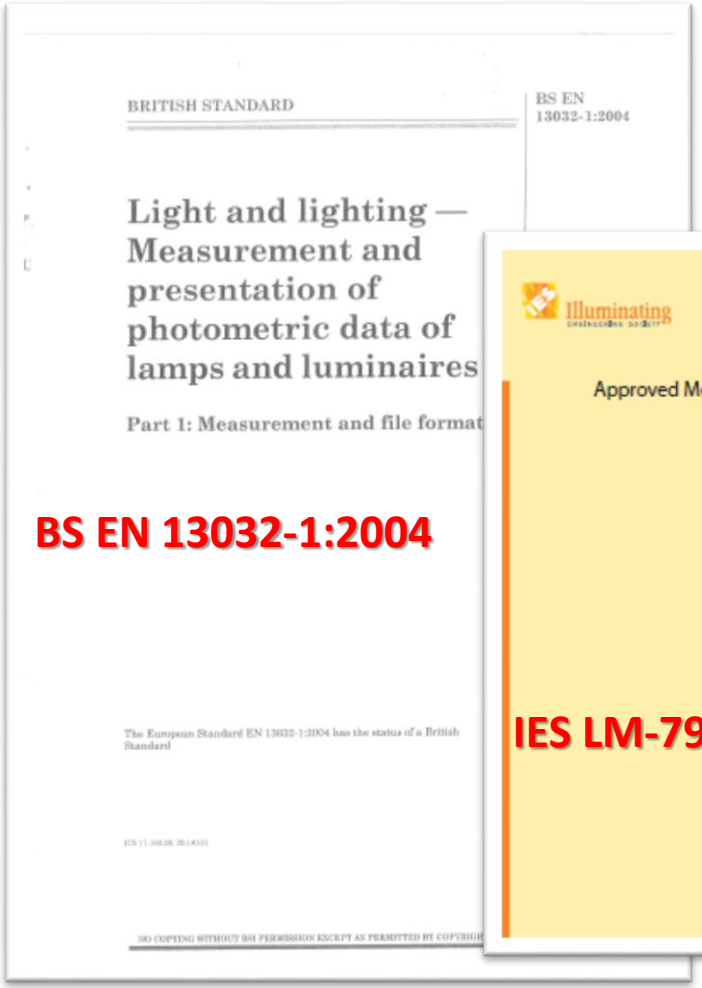
10,000 cd

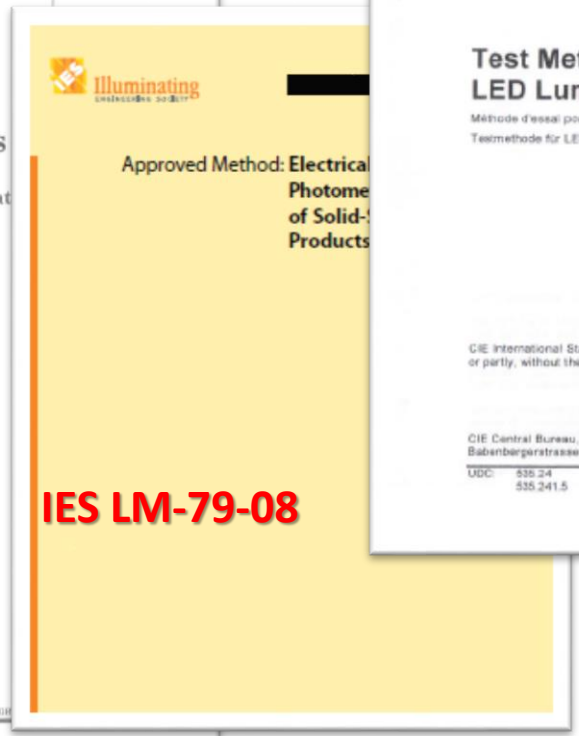
50,000 cd

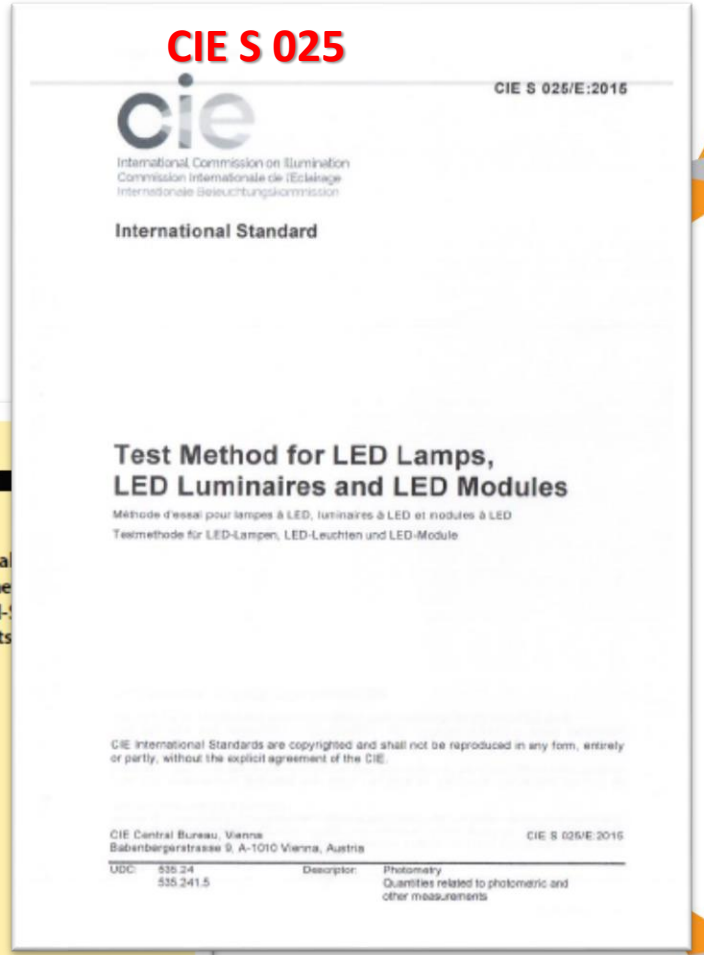
100,000 cd

TEST METHOD/STANDARD





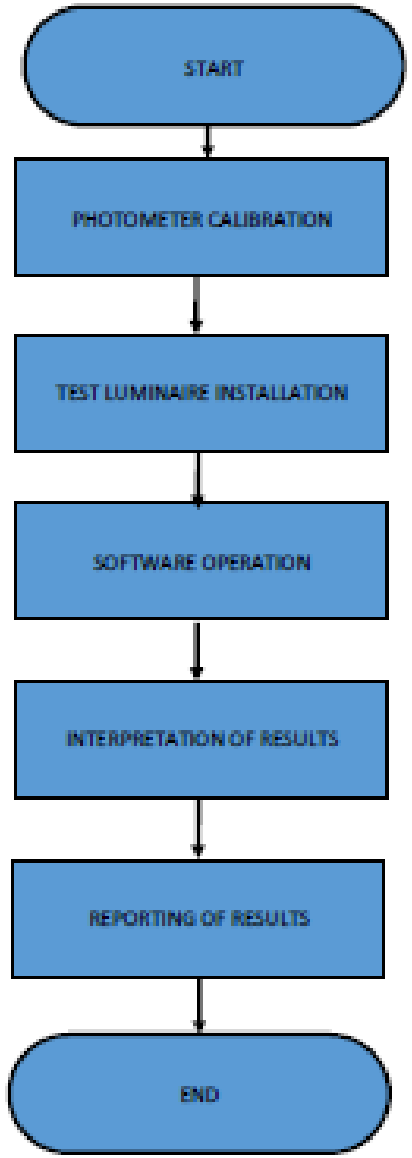




TEST CONDITIONS

DOCUMENT	IES LM-79-08	EN 13032 /CIE 121	CIE S 025
THERMAL CONDITIONS	25 ±1 °C	25 ±1 °C	25 ±1.2 °C
MEASUREMENT POINT	not more than 1 m from device and at the same height	Shall be measured at horizontal distance maximum 1.5 m	
TEST PROCEDURES			
Ageing / Seasoning	No aging	according to appropriate device standard	according to appropriate device standard
Stabilization of test device	within 0.5 % in 30 min	within 0.5 % in 15 min	within 0.5 % in 15 min
Operating position of LED device for goniophotometer	Type C. Burning position shall not change on goniophotometer	Shall not change	As per designed operating position or with applied corrections
Scanning angle resolution	22.5° hor. 5 ° ver.	as specified in application standard	45° or less (γ) ,Φ

PHOTOMETRIC TESTING PROCEDURE



PHOTOMETER CALIBRATION - STANDARD/CALIBRATION LAMP

LISUN GROUP

CALIBRATE CERTIFICATE

PRODUCT NAME: Luminous Intensity Standard Lamp
MODEL NUMBER: SLS-150W
SERIAL NO: BSRCR040024

Calibrate Current: 6.110A (DC)
Relative Intensity: 403.5cd
Reference Voltage: 24V
Calibrate CCT: 3173K

Period of Validity: 1 Year
Temperature: 25℃
Date of Calibration: 2016-06-27
Humidity: 65%

Data Trace to the National Institute of Metrology (NIM)

Notes:
1. The DC Power Supply's voltage output should be about 1 or 2V higher than the

PRODUCT NAME: Luminous Intensity Standard Lamp
MODEL NUMBER: SLS-150W
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Data Trace to the National Institute of Metrology (NIM)

TEST LAMP INSTALLATION- PHOTOMETRIC CENTRE

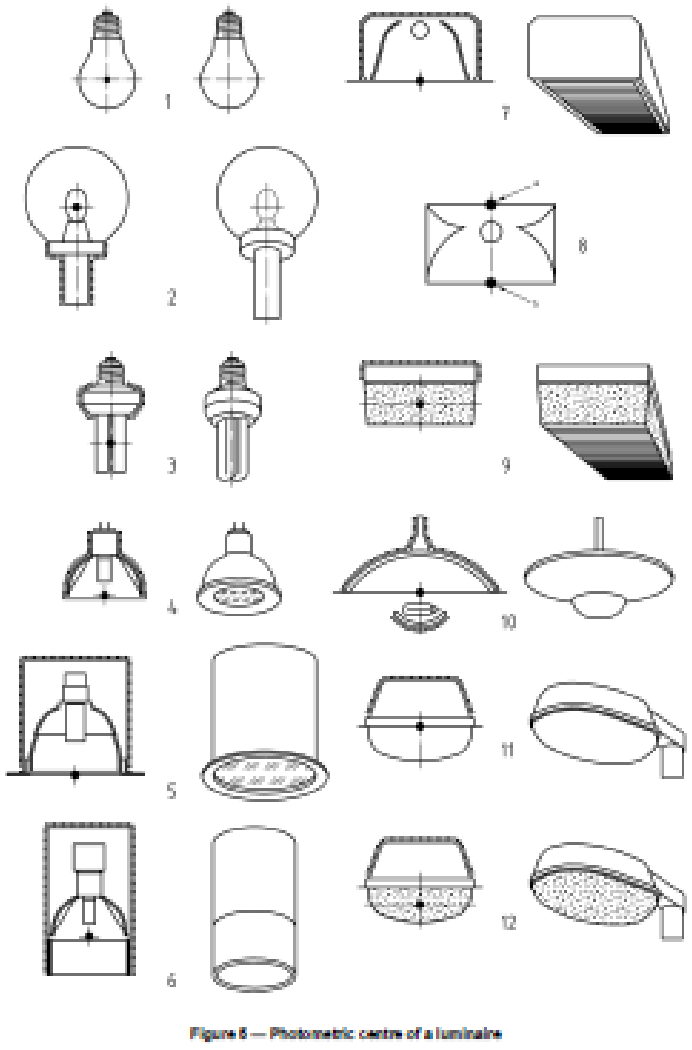


Figure 6 — Photometric centre of a luminaire

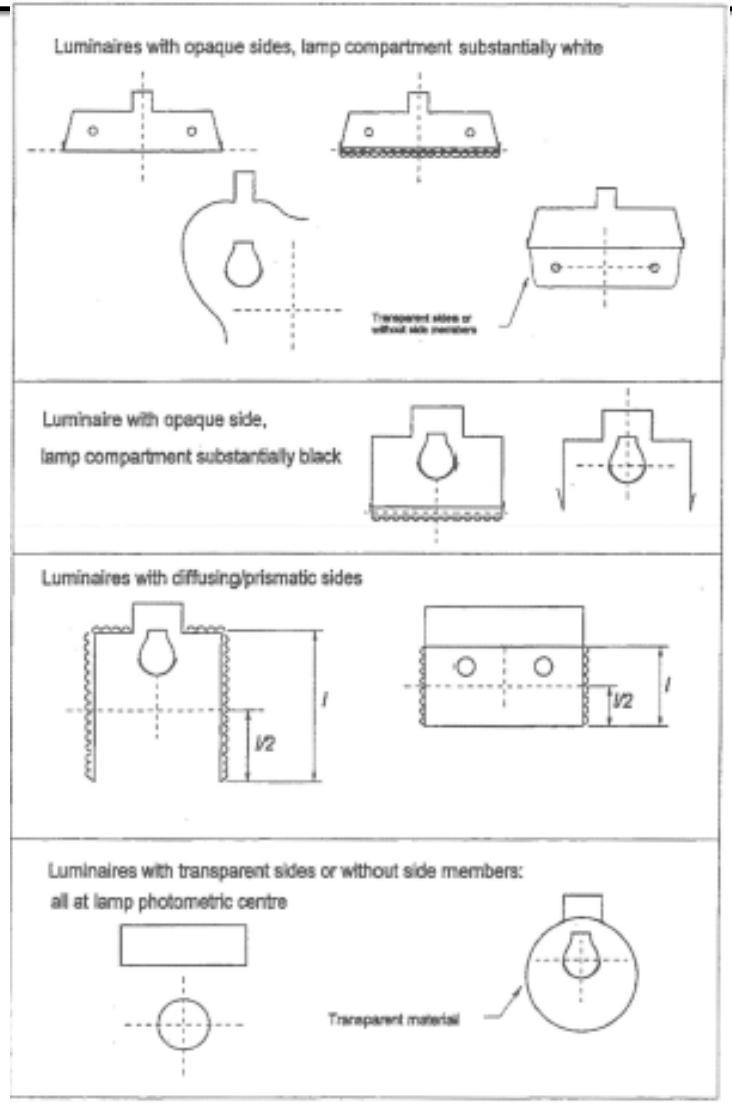
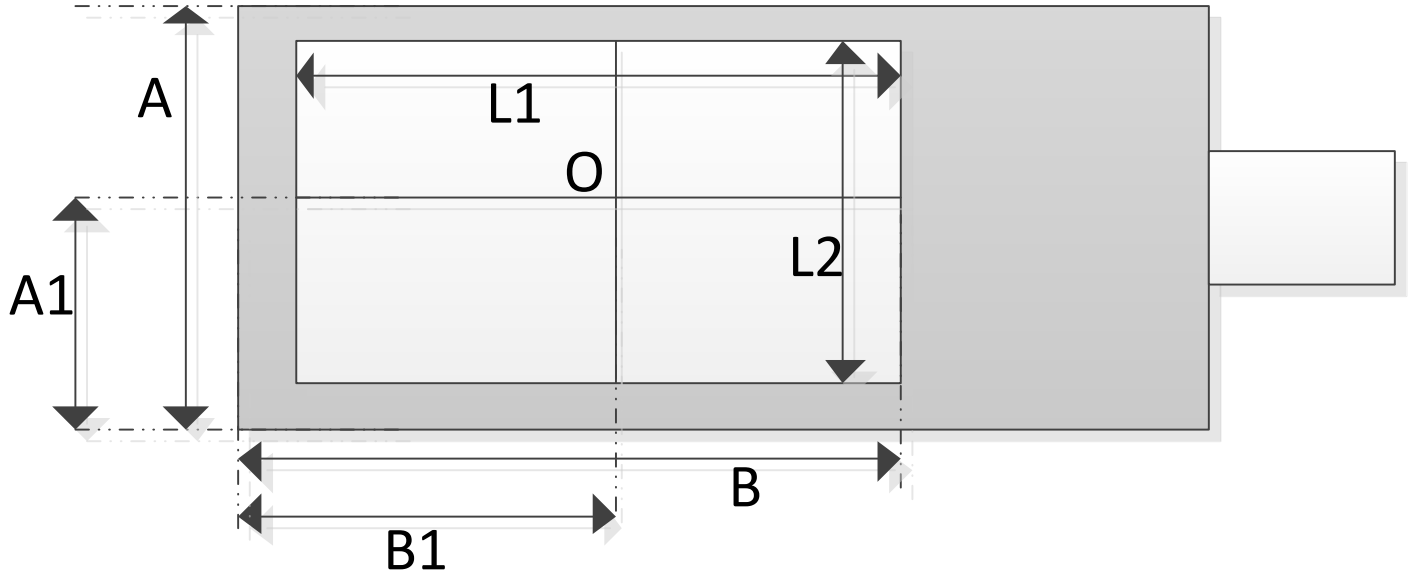


Figure 5. Photometric centres of various types of luminaire

EN 13032

MEASUREMENT OF LIGHT CENTRE

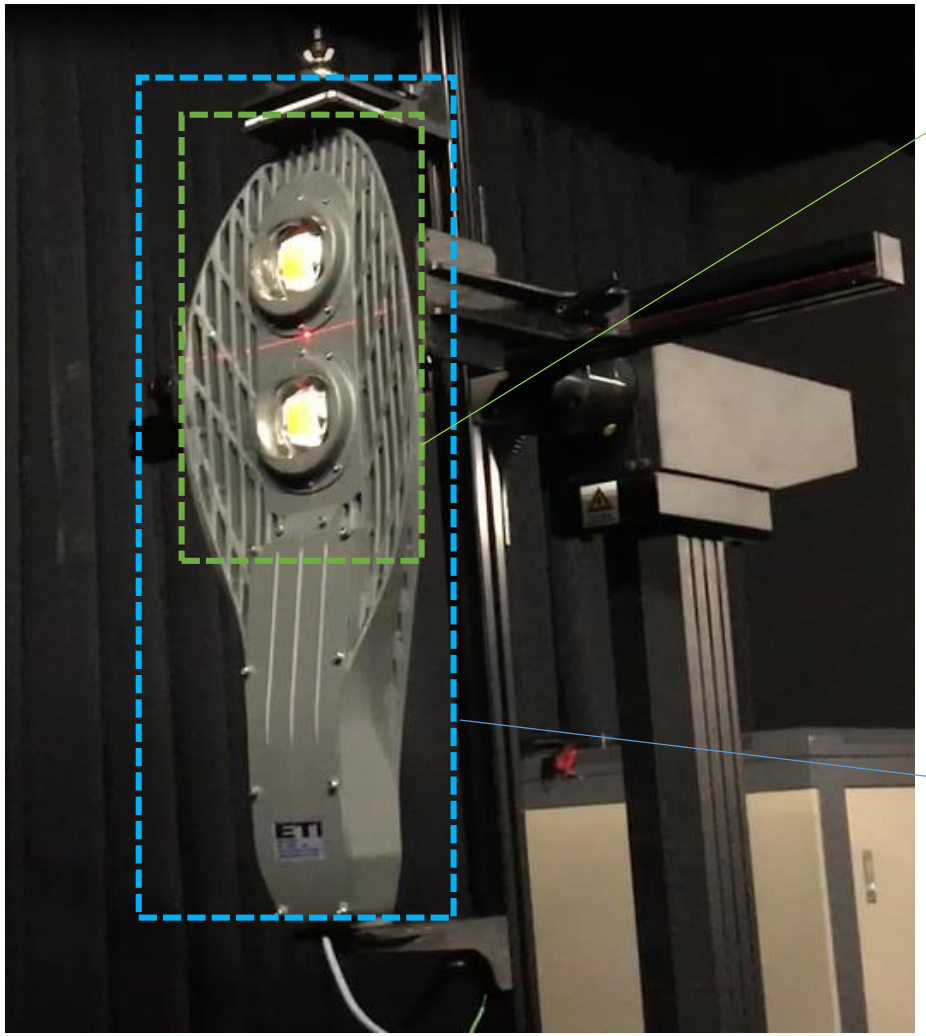


LIGHT CENTRE O, L1,L2,A,B,C

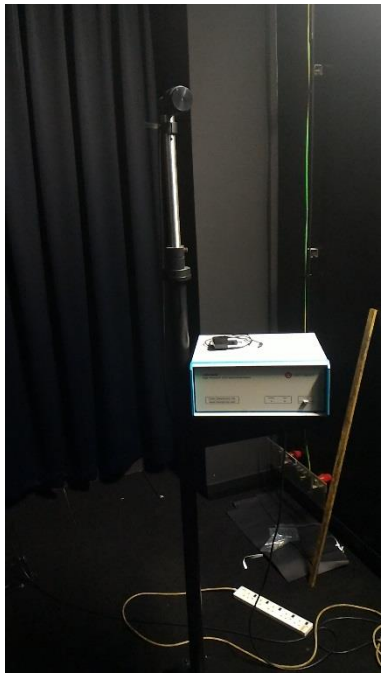
A1=A/2

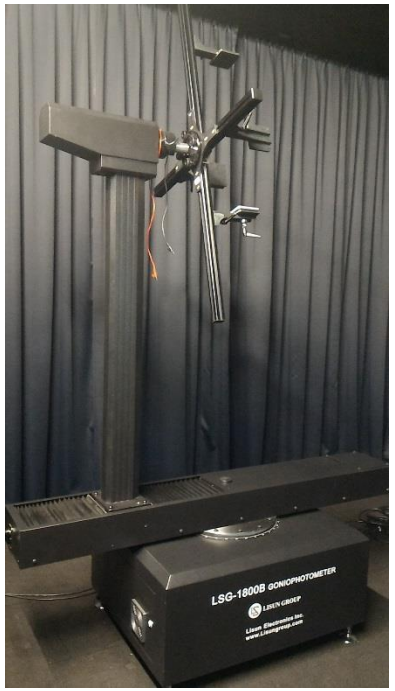
B1=B – (L1)/2

MOUNTING OF LUMINAIRE

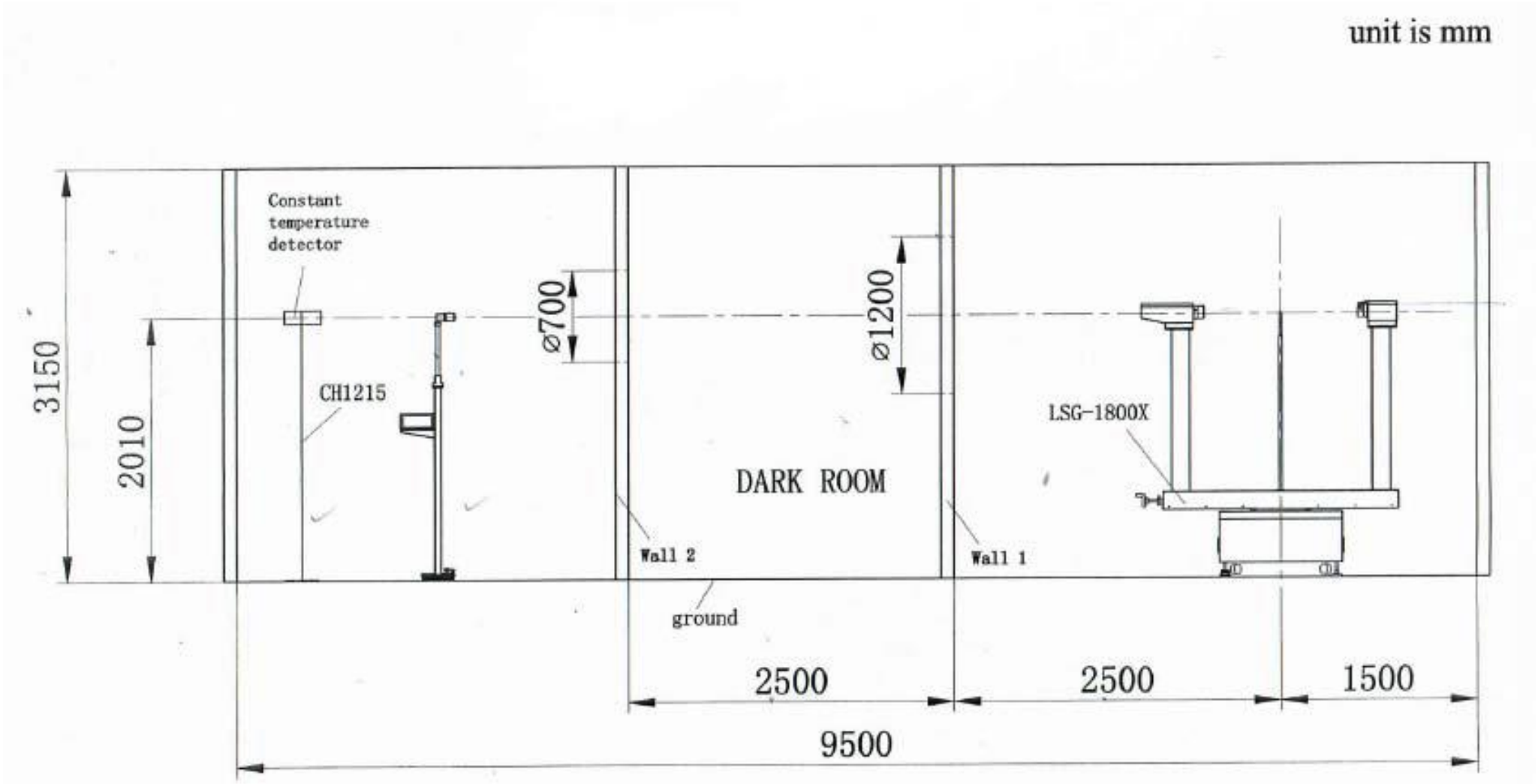


TESTING EQUIPMENT



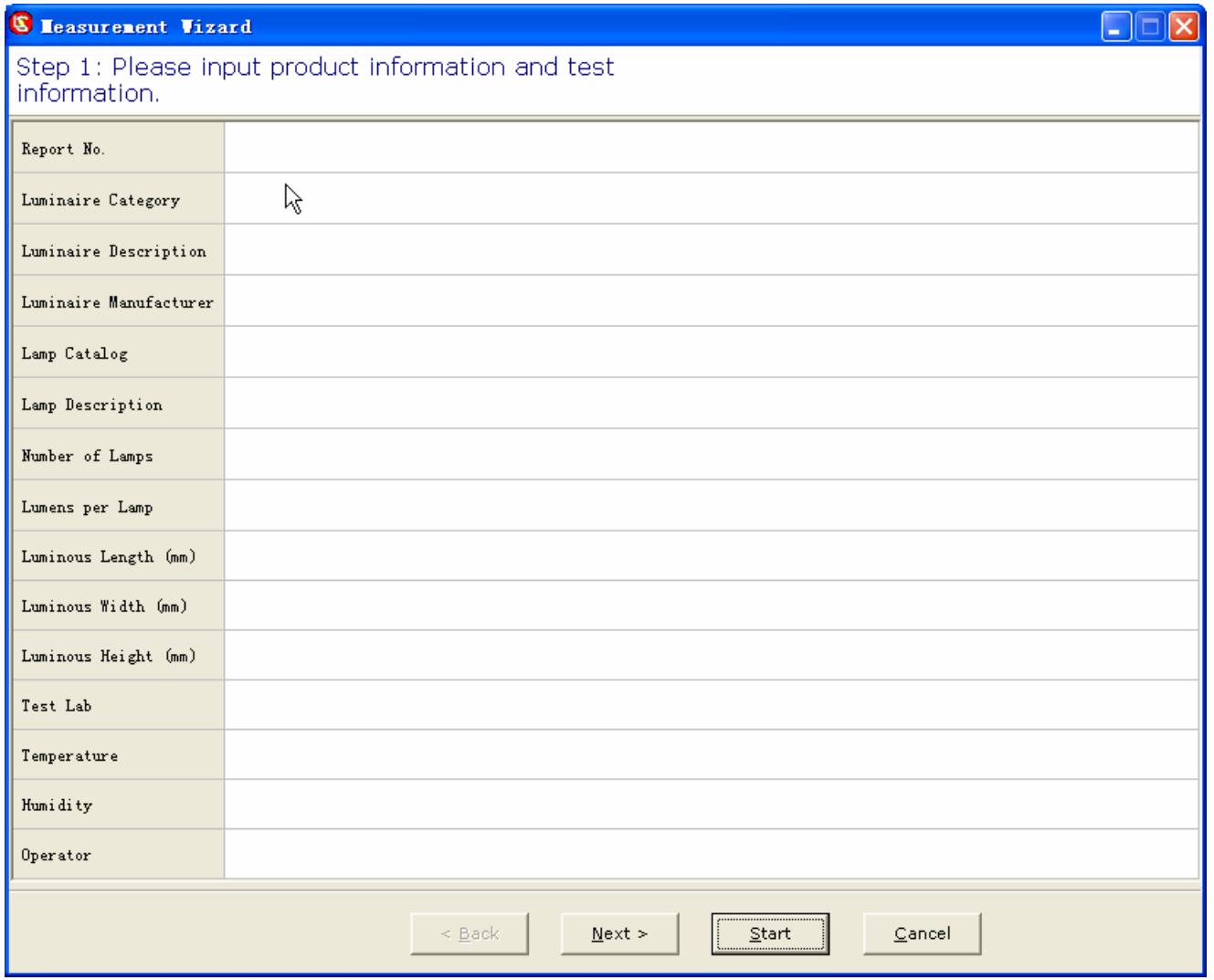


TESTING EQUIPMENT- DARK ROOM LAYOUT

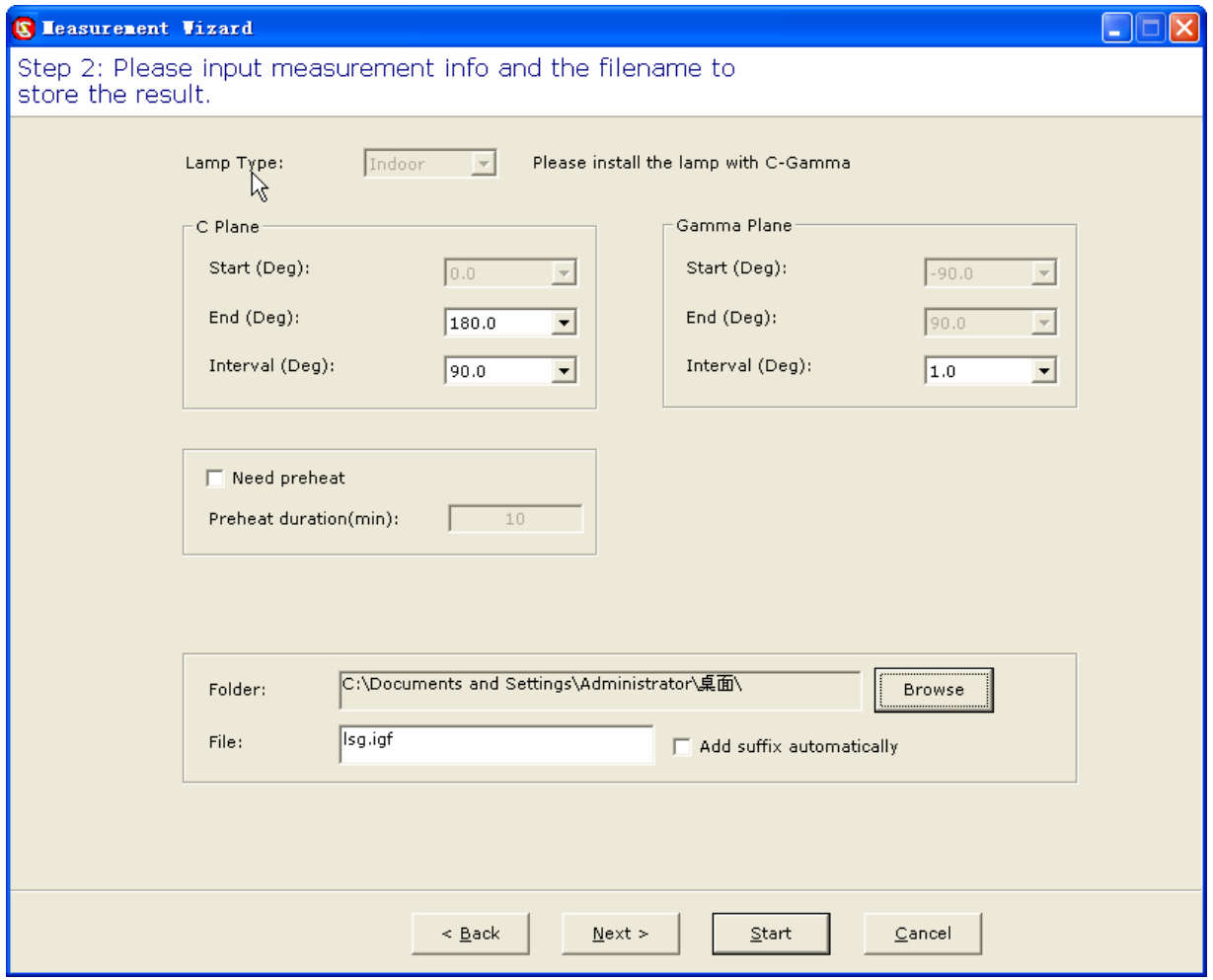


SOFTWARE OPERATION- MAIN WINDOW

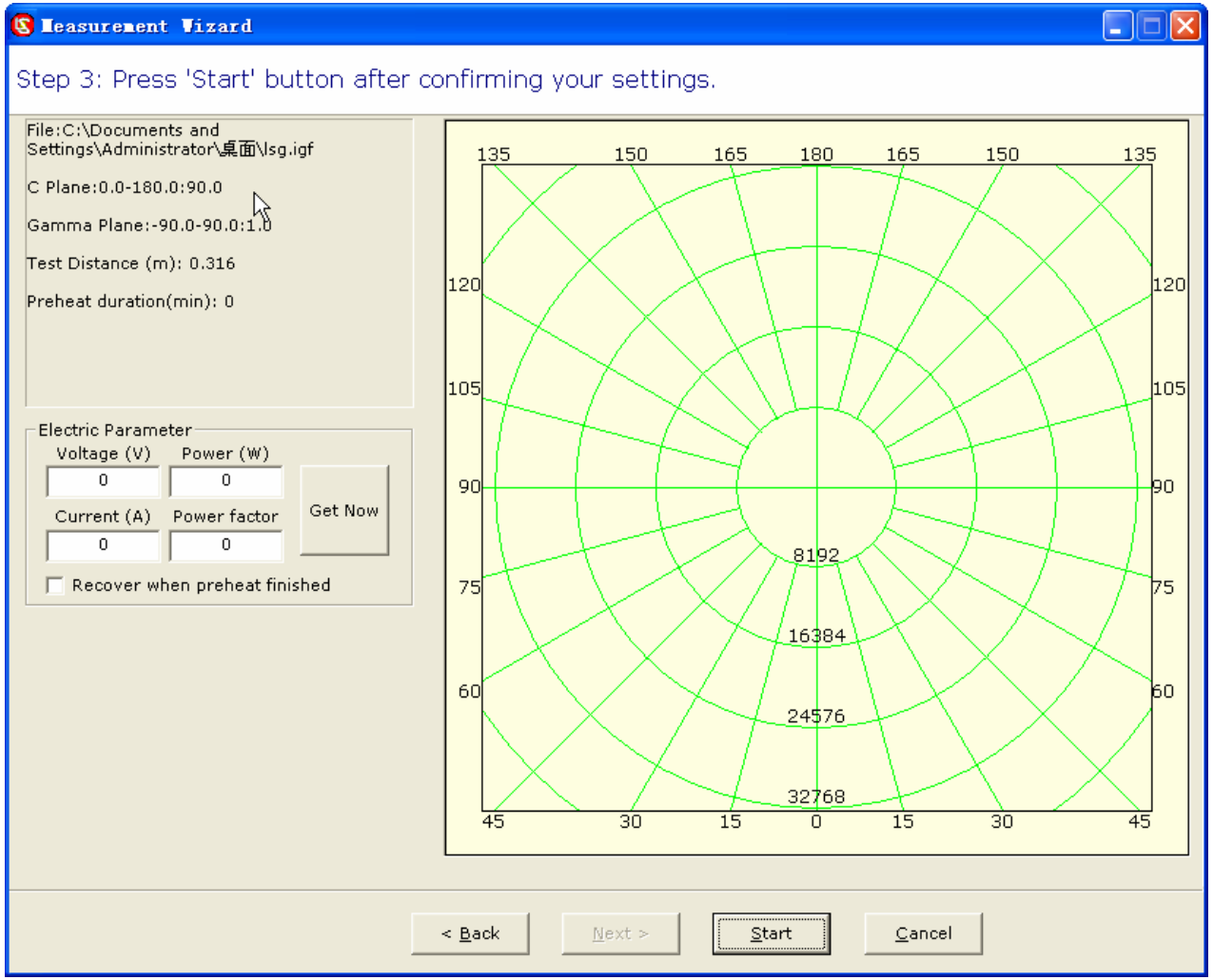
SOFTWARE OPERATION- STEP 1



SOFTWARE OPERATION – STEP 2



SOFTWARE OPERATION – STEP 3



REPORTING OF RESULTS

PUSAT KECEMERLANGAN KEJURUTERAAN DAN TEKNOLOGI JKR (CREaTE)
CREATE.JKR.GOV.MY
Tel:06-5512322
Fax:-

Report No.: 01012017 Test Time: 23/1/2017 19:06

Luminaire Property

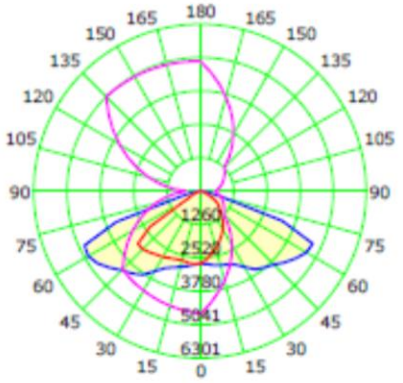
Luminaire Manufacturer:
Luminaire Category: AMENITIES LIGHTING
Lamp Catalog: LED
Number of Lamps: 42
Voltage: 230.1 V
Power: 118.61 W
Luminaire Description: ENERSUN
Lamp Description: MODULAR TYPE
Lumens per Lamp: 300
Current: 0.540 A
Power Factor: 0.954

Photometric Results

IES Classification: Type I
Total Rated Lamp Lumens: 12600.0 lm
Efficiency: 94.55%
Upward Ratio: 0.00%
Central Intensity: 2734.42 cd
Pos of Max. Intensity: H225 V60
Longitudinal Classification: Short
Measurement Flux: 11913.8 lm
Downward Ratio: 94.55%
Luminaire Efficacy Rating (LER): 100
Max. Intensity: 5041.05 cd

Picture Of Luminaire

Luminous Intensity Distribution Curve



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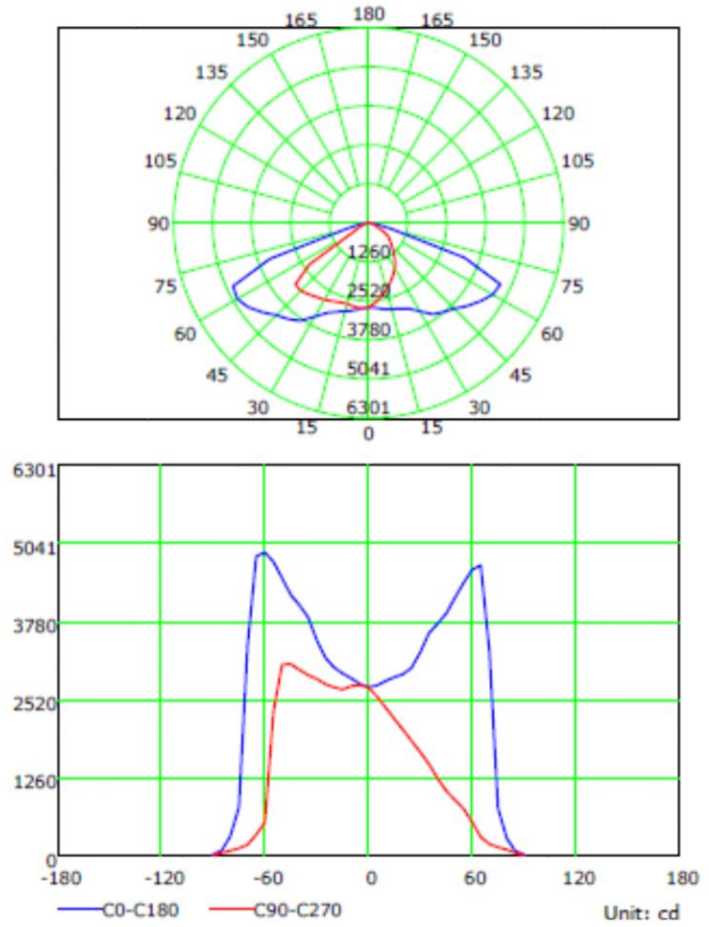
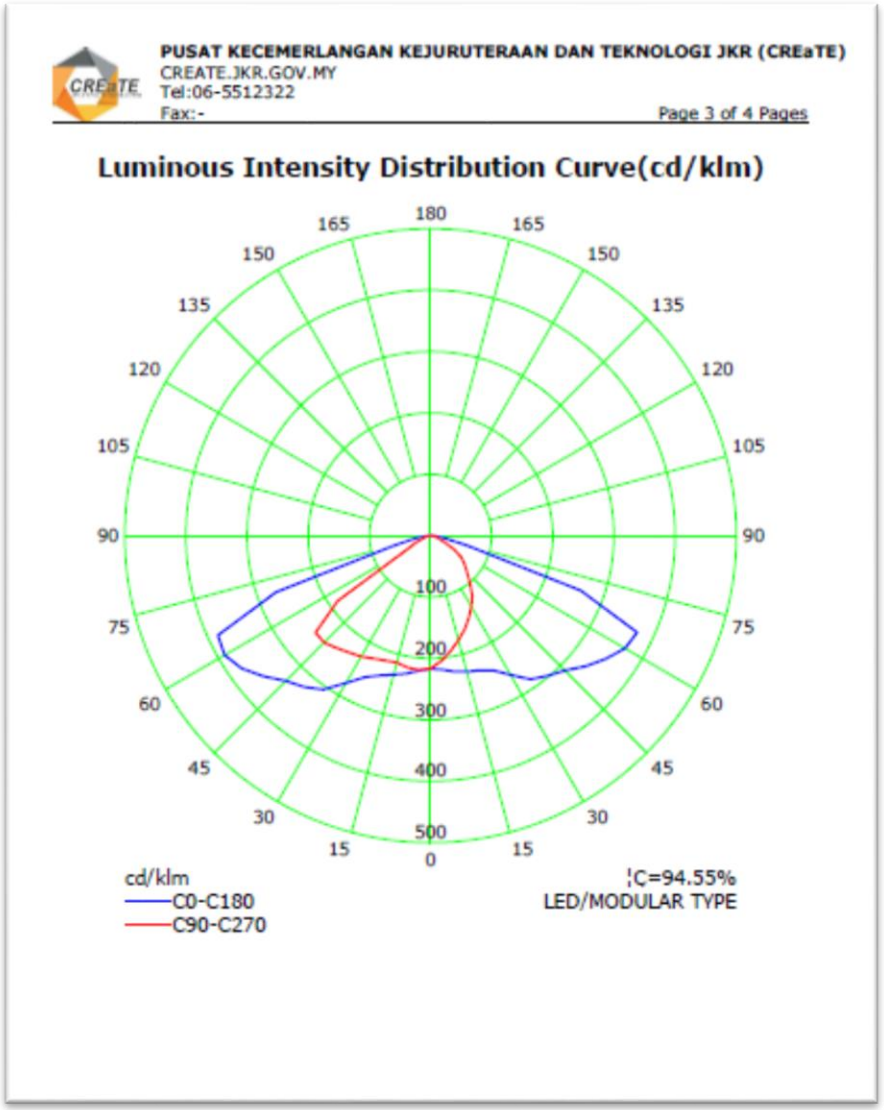
CREATE.JKR.GOV.MY
Tel:06-5512322
Fax:-

Luminous Intensity Distribution Curve



REPORTING OF RESULTS



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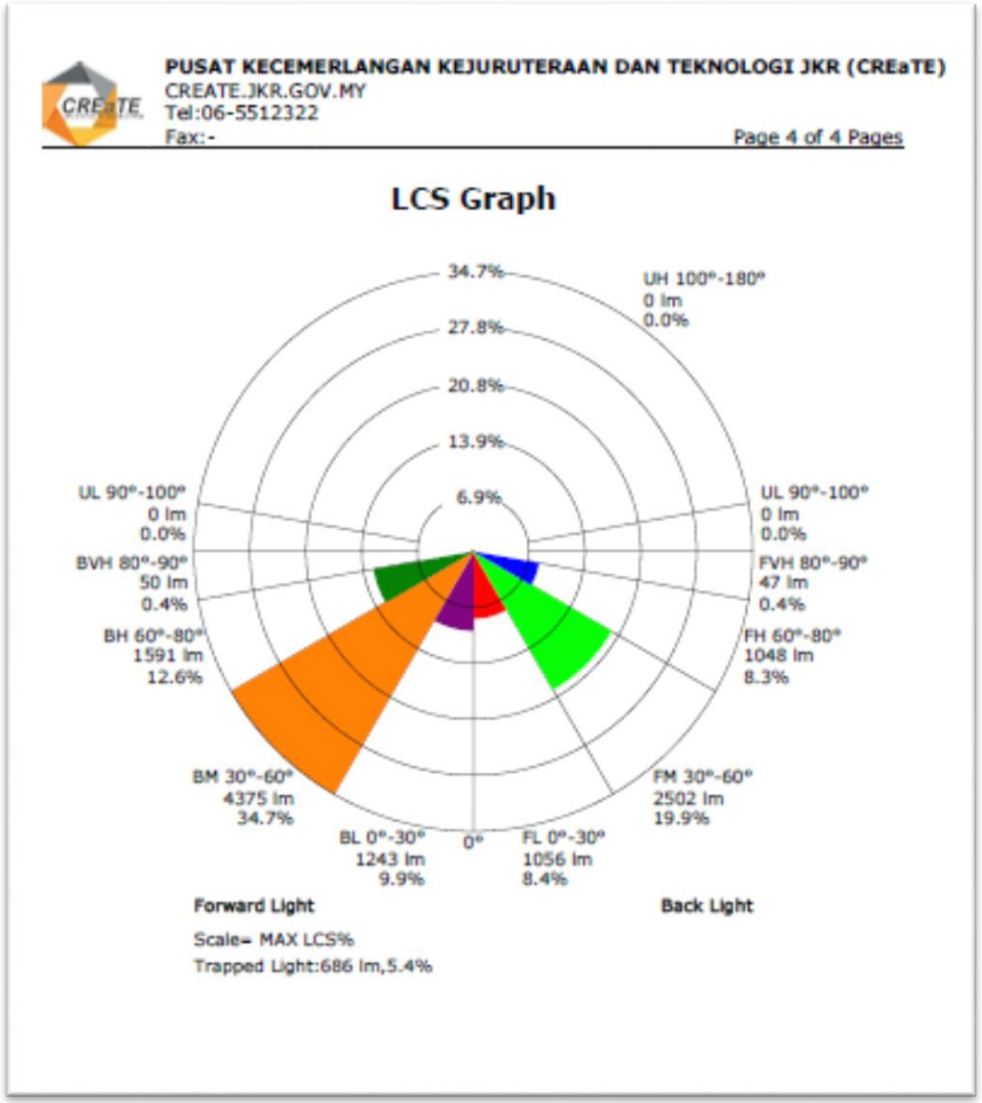
Page 3 of 4 Pages

Luminous Intensity Distribution Curve(cd/klm)



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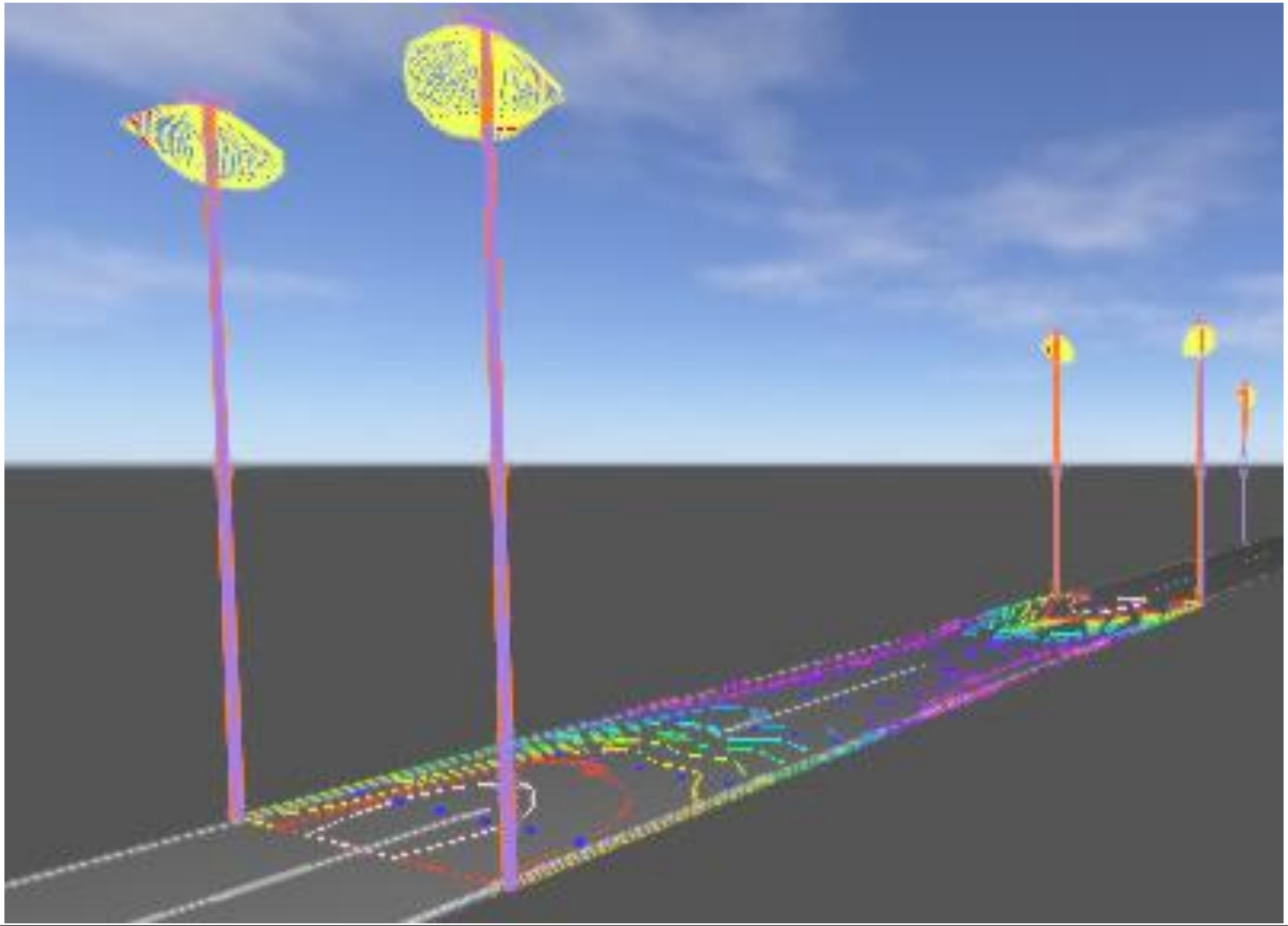
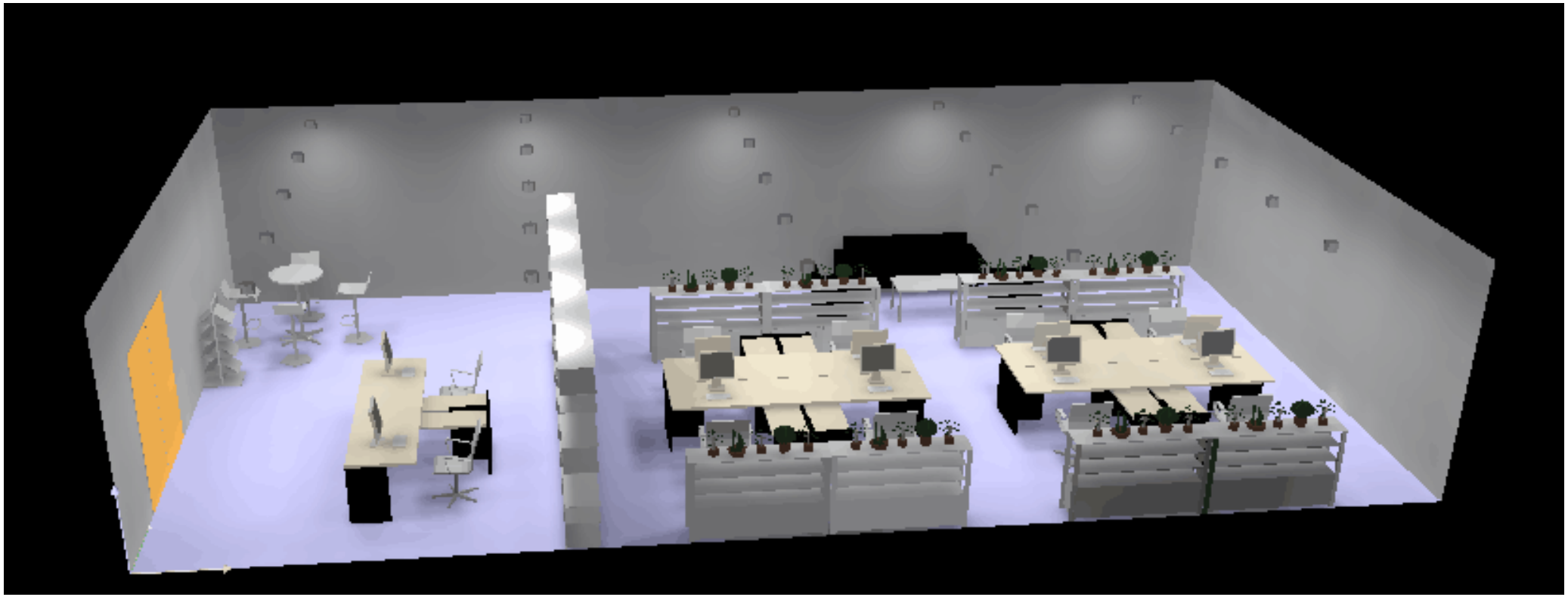
LCS Graph

LIGHT SIMULATION – OUTDOOR



LIGHT SIMULATION – INDOOR




SEKIAN TERIMA KASIH
ご清聴　ありがとうございました