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The Meaning and Purpose of Essential Lighting Parameters in Practice

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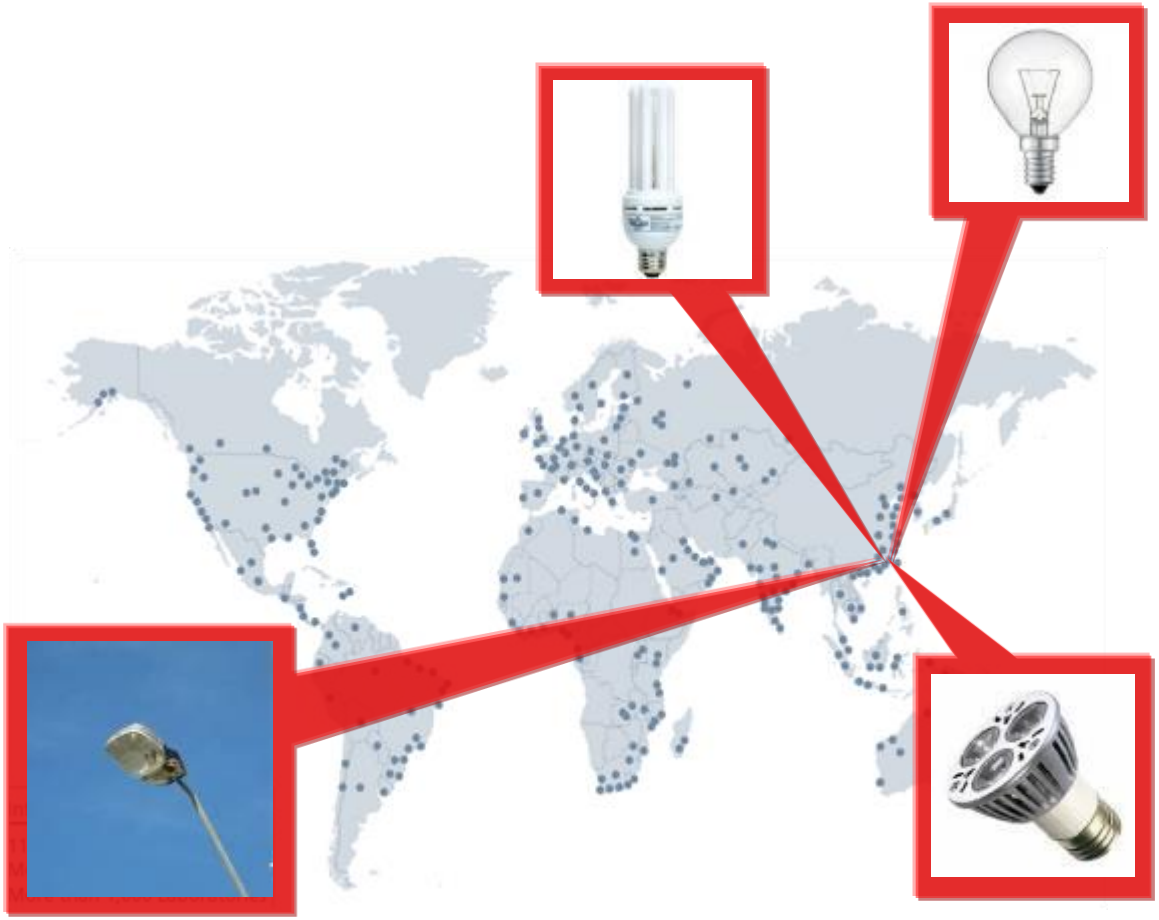
Key Considerations for LEDs:

Performance Testing

- Photo-biological Hazard
- Safety Testing
- EMC / FCC



LED Performance Test Parameters

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1. Luminous Flux (Lumen)
2. Efficacy (Lumen/Watt)
3. CCT (Correlated Color Temperature)
4. CRI (Color Rendering Index)
5. SDCM (Standard Deviation of Color Matching)
6. Starting Time
7. Run up Time
8. Light distribution
9. Color Spatial Uniformity
10. LED chip's Case Temperature
11. Lumen Maintenance
12. Noise measurement

LED Lamps

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1. Luminous flux

Quantity derived from radiant flux by evaluating the radiation according to its action upon the photometric observer.

Lumen is the **unit of luminous flux**

In simple terms:

The total light output of the lamp / luminaire

i.e. How bright is the lamp / luminaire

Integrating Sphere Testing System in Intertek Testing Facility

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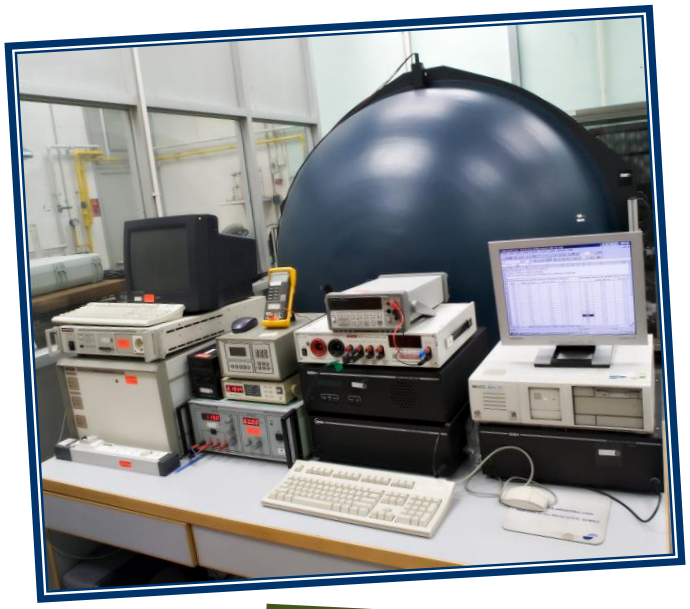

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Note:

For CFL products, 100hour pre-conditioning is required. However, for LED products, pre-conditioning (seasoning) is NOT required prior to the initial lumen measurement.

2. Luminous Efficacy (lumen/ watt)

The total light output divided by the total power input

LED products is normally in the range 50lumen/watt to 100lumen/watt.

Also, if the design is the same, higher CCT product will normally have higher lumen efficacy when compare to lower CCT product.

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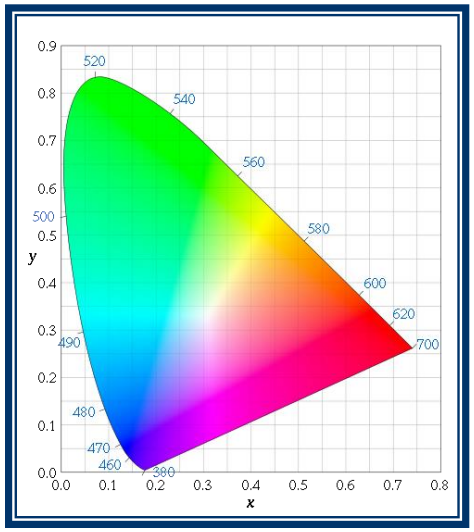
3. CCT (Correlated Color Temperature)

The color temperature of a light source is the temperature of an ideal black-body radiator that radiates light of comparable hue to that of the light source.

i.e. The color of the light emitted and the unit is in K

Lamp with lower CCT (e.g. 2700K) will appear to be yellowish (i.e. the light is warmer).

As the CCT increase, the color of the light will gradually change to whitish (e.g. 6500K lamp) and the light is cooler.



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3. CCT (Correlated Color Temperature)

Warmer light (e.g. 2700K) makes people feel more relaxed. Therefore this type of lamp is commonly used in restaurants.

Cooler light (e.g. 6200K) lets people feel more energetic. Therefore it is preferred in working environment and office.

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4. CRI (Color Rendering Index)

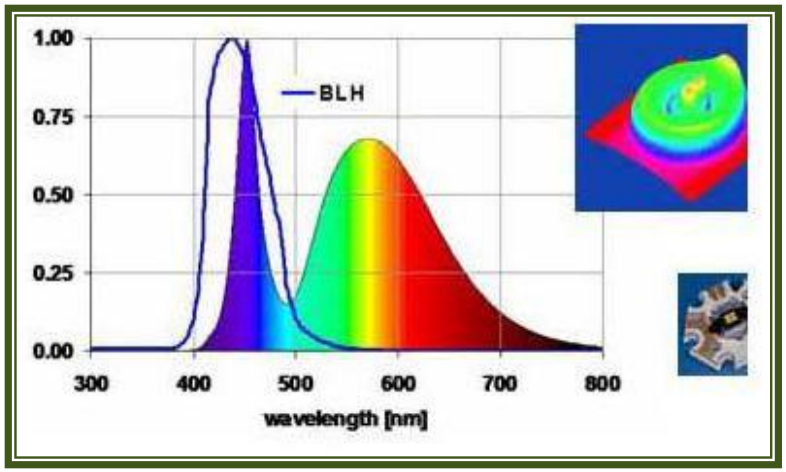
CRI describes how colors are rendered under an artificial source of light. It is in % and the max. is 100%.

This indicates how well is the light source be able to reproduce the color of any object. The higher the value means the better is the light source to reproduce an object's color.

For ordinary home usage, CRI >= 80

For outdoor usage, CRI >=76

For area requiring good color reproduction (e.g. food shop, CRI >=84



Color Rendering Index (CRI)???

Picture A

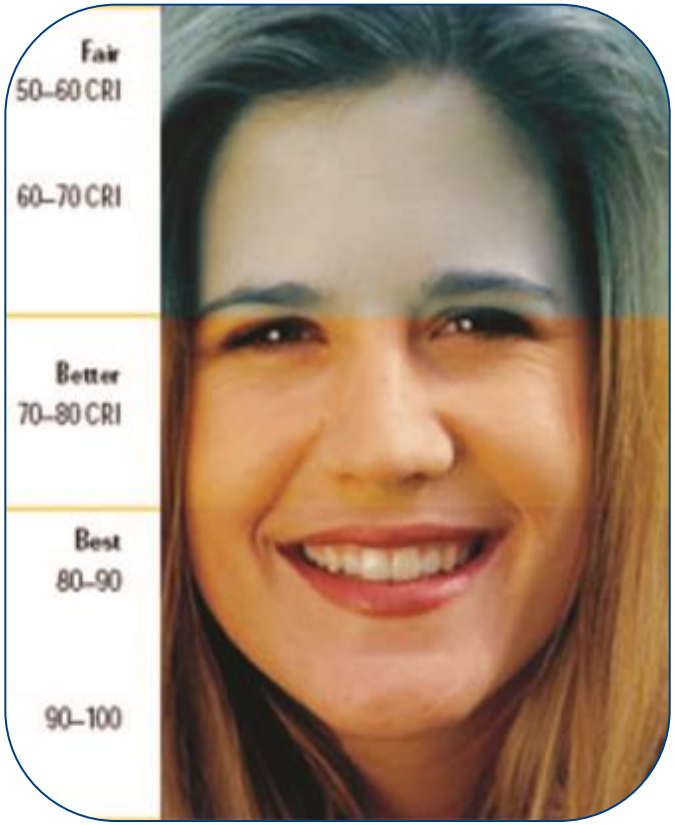
CCT 3000 (°K)
CRI - 52

Picture B

CCT 3000 (°K)
CRI - 82

Picture C

CCT 6500 (°K)
CRI - 82



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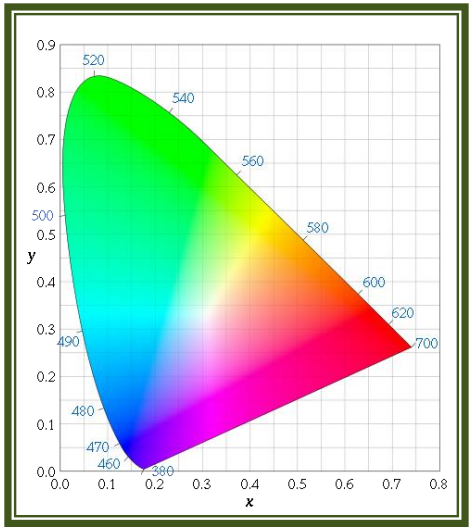
5. SDCM (Standard Deviation of Color Matching)

SDCM indicates the “spread” (or “variation”) of the light color of each lamp against the “rated” CCT of the lamp. It is a pure number without any unit.

This is an indicator showing the consistency of CCT among different lamps. The smaller is SDCM value, the better is the consistency of the CCT.

There is normally multiple LED lamps installed in a single location (e.g. hotel lobby), a small SDCM will garanttee a consistent “color” of the lamps. Normally, a SDCM of 5 or 7 is required.



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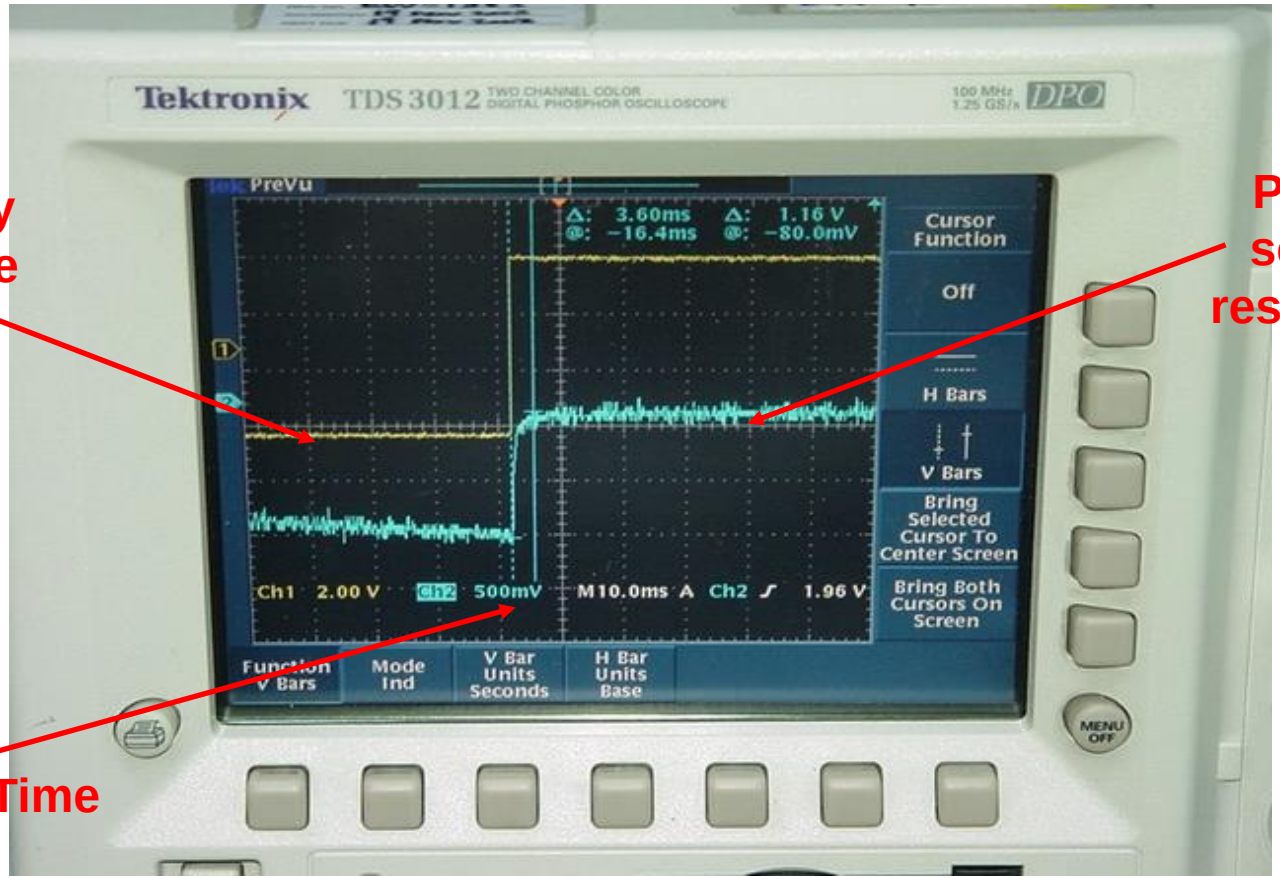
6. Starting Time

The time required for the lamp to start fully right after the supply voltage is switched on.



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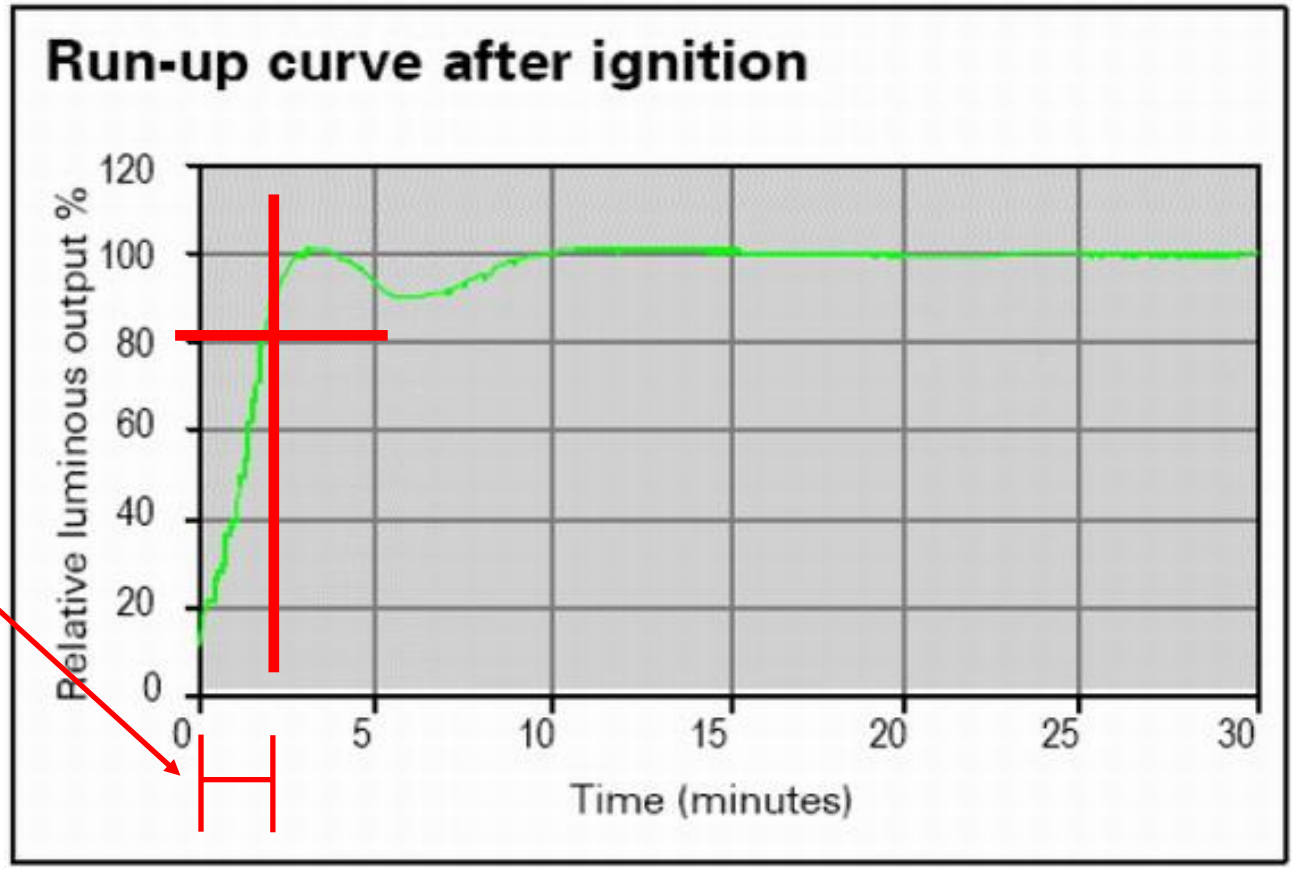
7. Run-up Time

The time required for the lamp to reach 80% of the final luminous flux after the supply voltage is switched on.



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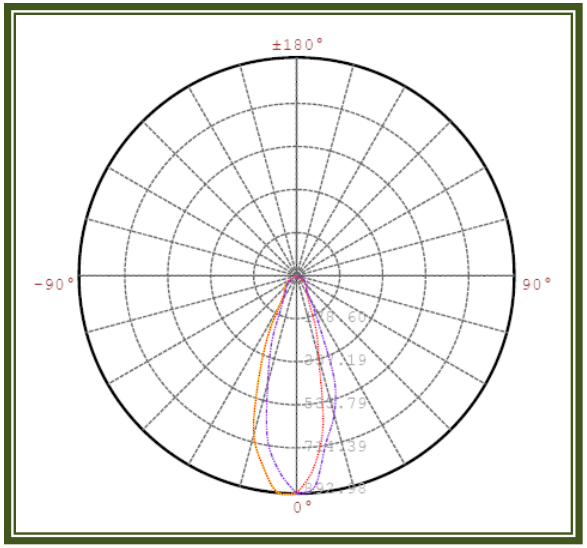
8. Light distribution

Only the total lumen value cannot provide sufficient information on how “bright” is the lamp for the designated area.

The light distribution property is required to determine if the lamp can provide the right amount of light to the required lighting surface.

Since LED light output is sensitive to temperature changes, the LED lamp must NOT be tilted during light distribution measure, Type-C (mirror type) goniophotometer is required.



Light Distribution

Type C (Mirror Type) Goniophotometer in Intertek Testing Facility

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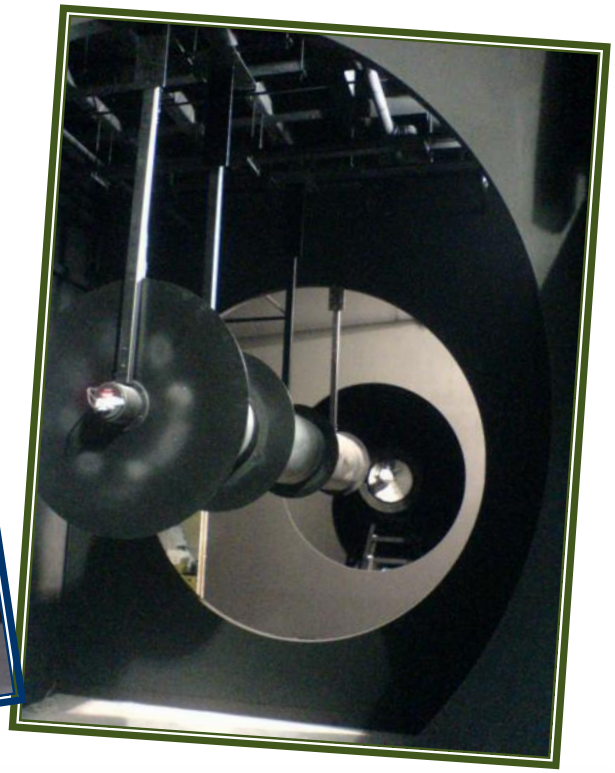

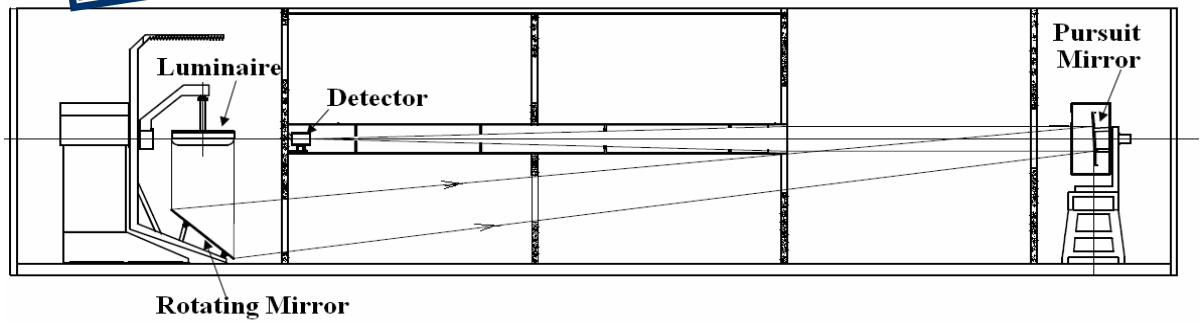

Equipment Size:

Tall	4 m
Length	13 m
Max. Sample Weight	50 kg

Chamber Size:

High	4.3 m
Wide	4.3 m
Length	15 m

Type C (Mirror Type) Goniophotometer in Intertek Testing Facility

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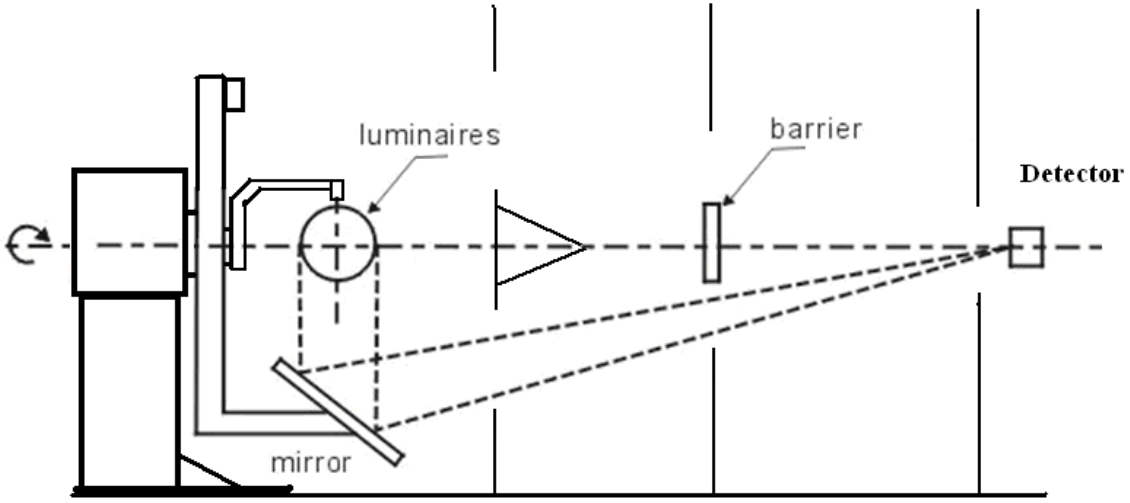

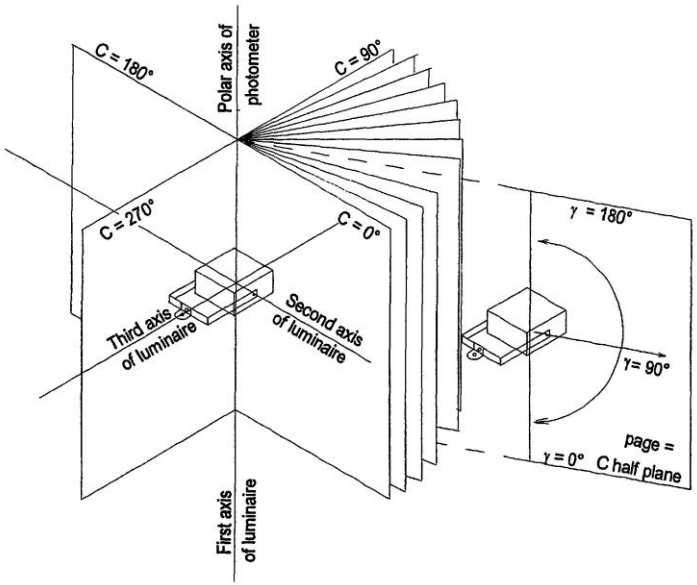

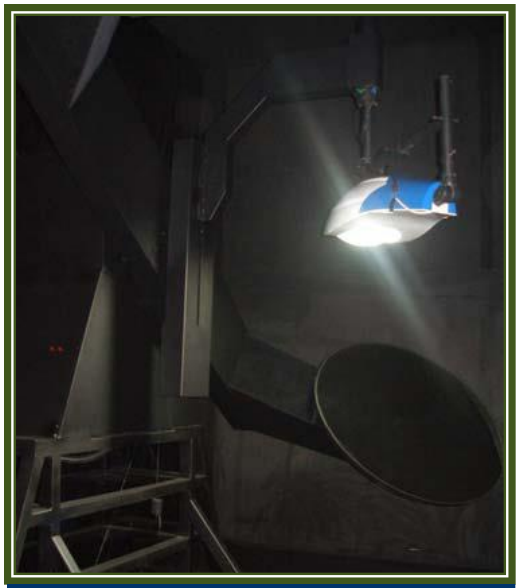

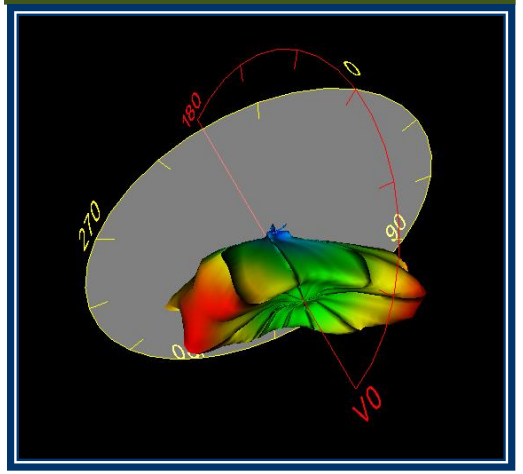

Light Distribution Pattern

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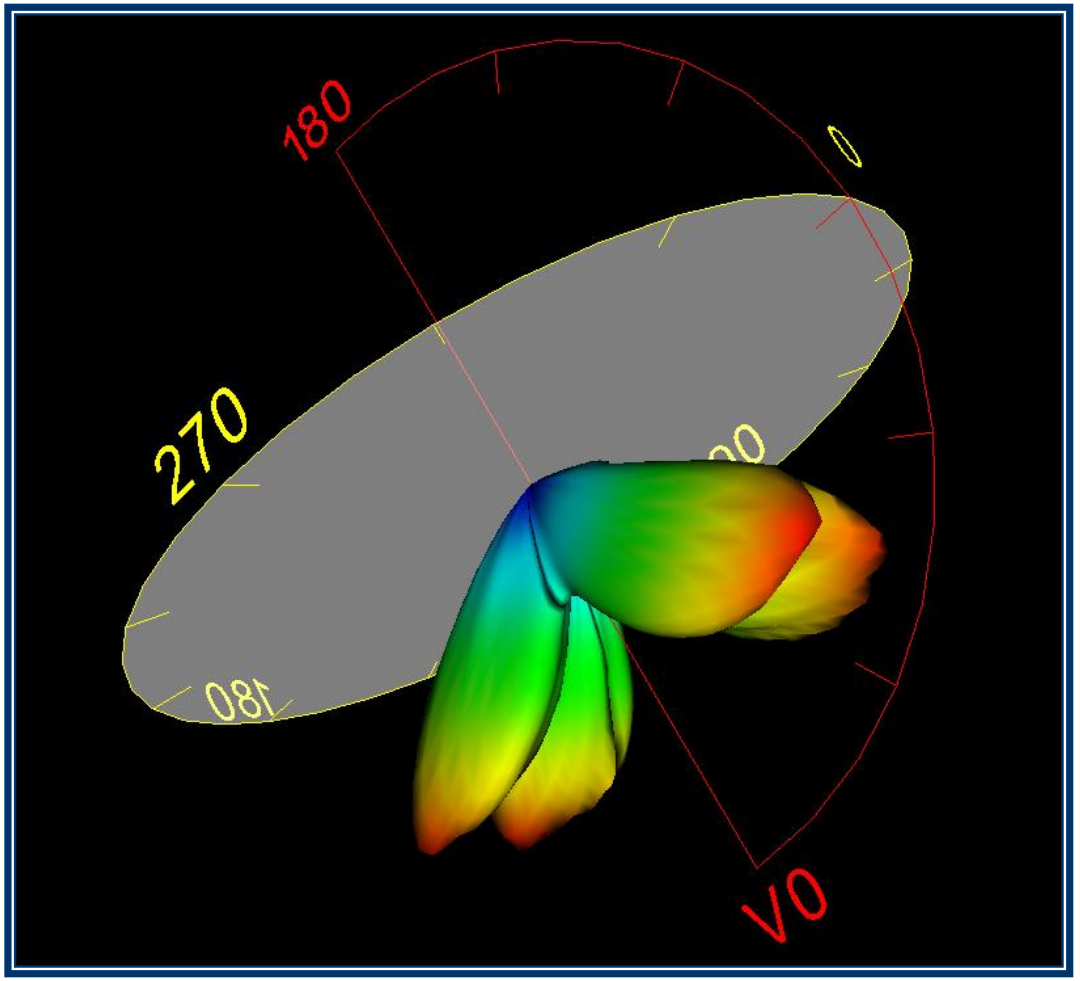
Street Light



Light Distribution Pattern

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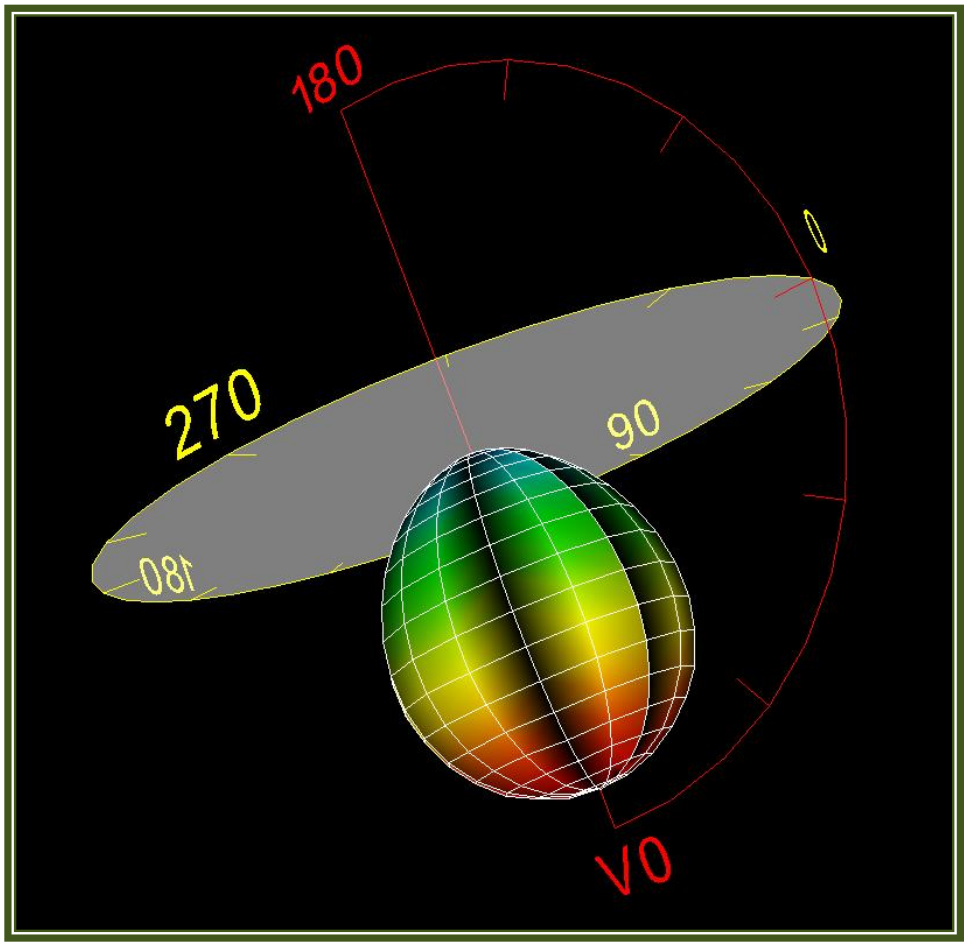
Downlight



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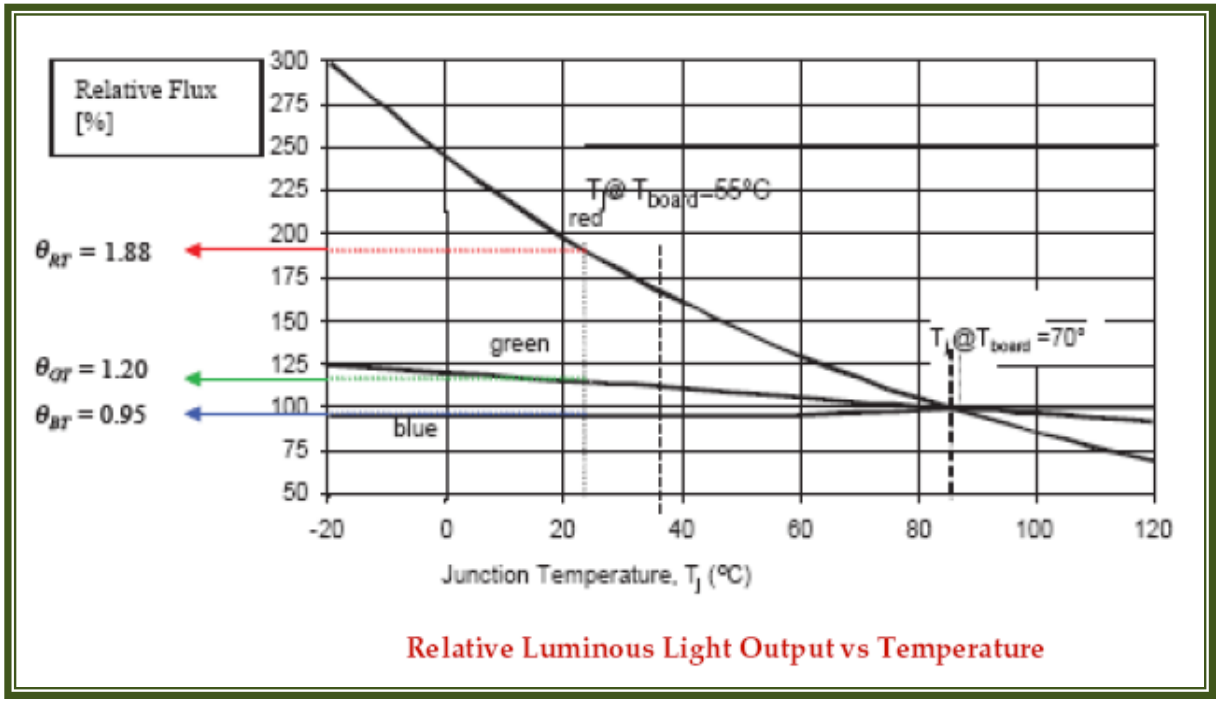
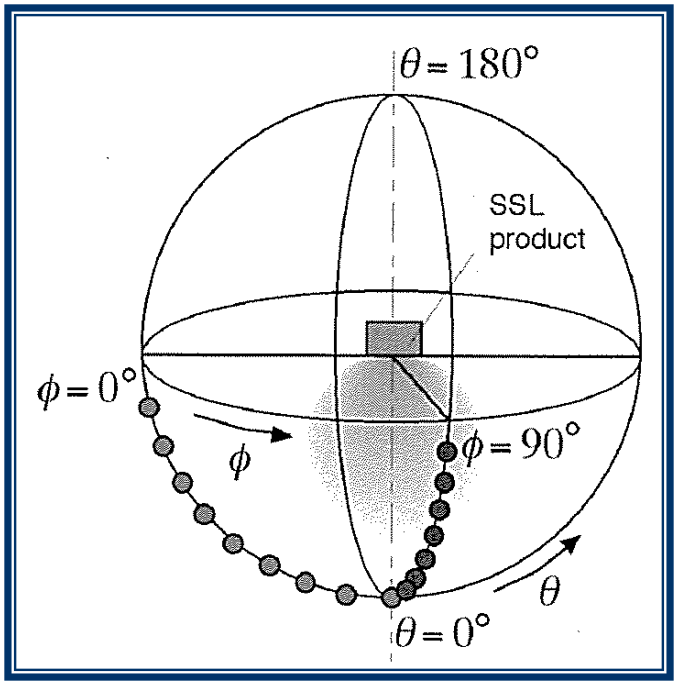
9. Color Spatial Uniformity

ENERGY STAR® Program Requirements for Lighting product. It checks out if the light emitted is with a consistent color. This is especially critical if the lamp is mixing multi-color LEDs for generating white light.





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10. LED chip's Case Temperature

HEAT sensitive is one of the characteristics of LED.

With higher temperature ⬆, **LIGHT** output will be lower ⬇

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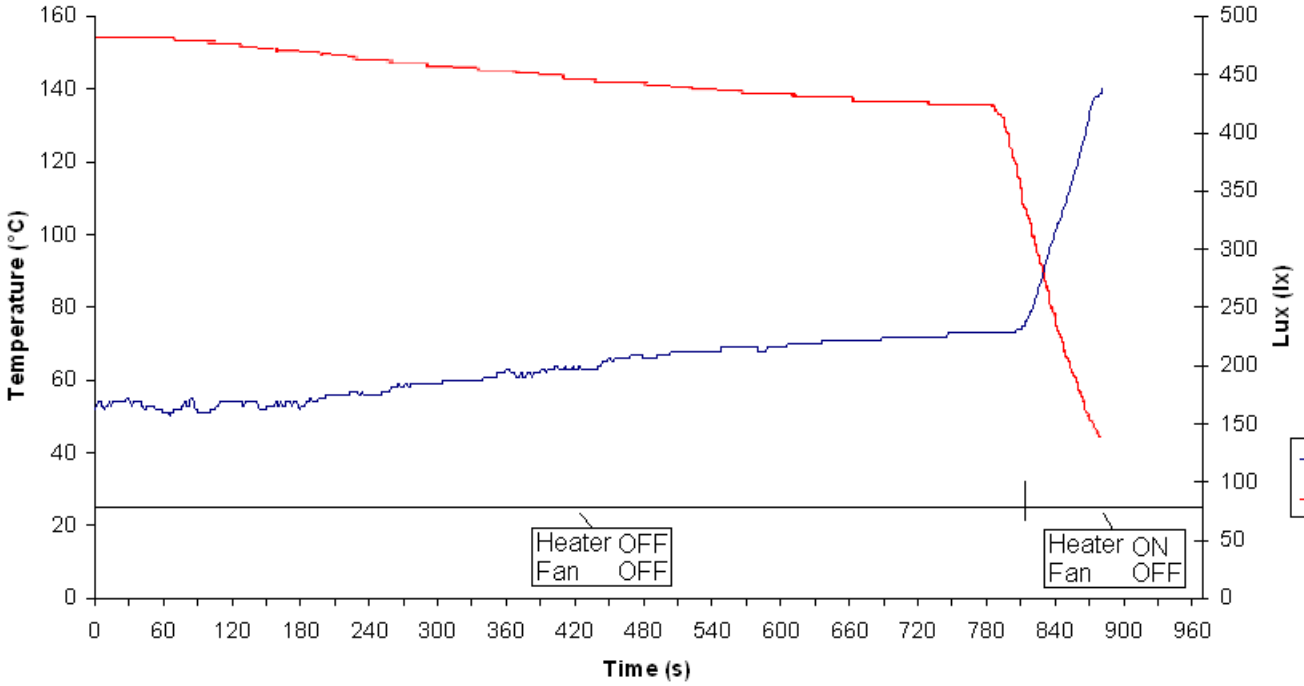

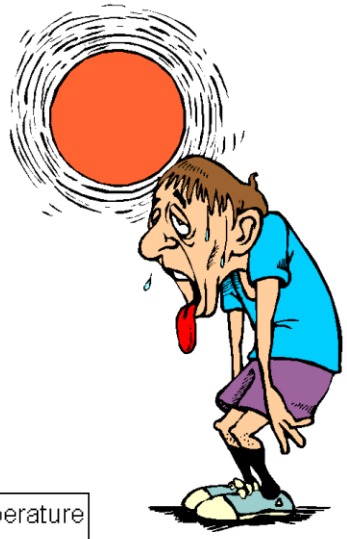

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10. LED chip's Case Temperature

The performance and life of the LED product depends on the operating temperature of the LED chips and this temperature MUST be within the LED chip's case temperature specifications.

The highest temperature LED chip must first be determined and selected. The thermal couple should then be attached to the LED chip's case temperature measuring point.

The measured LED case temperature is then checked against the LED specifications.

LED Performance Test Parameters

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11. Lumen Maintenance

For ensuring the LED luminaire be able to meet the Lumen Maintenance requirement, the LED chips selected should be with the LM80/TM21 test reports.

If the reports are not available, the luminaire will then be required to undergo the Lumen Maintenance test for 6,000hours as according to the ENERGY STAR® Program Requirements.

LM80 System in Intertek Testing Facility

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IES LM80: Approved Method: Measuring Lumen Maintenance of LED Light Sources

Focus on LED modules, arrays and devices :

Capable to test for LED component with rated power over 200W!

1. At least 6,000 Hours Lumen Maintenance with data collection at a minimum of every 1,000 hours
2. Electrical and Thermal Management (55°C, 85°C, and temperature selected by Manufacturer)

12. Noise measurement

ENERGY STAR® Program requires that the LED lamp / luminaire be operated with a noise level meeting the following requirements:

Class A sound rating for electronic ballast within the fixture, not exceed 24 dBA.

This is required as the oscillating circuit inside the LED lamp / luminaire may produce audibled noise.

Global Programs for LED Performance

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Area	Mandatory Program	Voluntary Program
North American	CEC	Energy Star
Europe	ErP Directive	
Asian Countries	CNS15630	

Ecodesign and Energy Labelling Requirements in EU

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Product Scope

a) Directional Lamps;

b) Light-emitting diode (LED) Lamps;

c) Equipment designed for installation between the mains and the lamps, including lamp control gear, control devices and luminaires (other than ballasts and luminaires for fluorescent and high-intensity discharge lamps);

d) Also establishes product information requirements for special purpose products.

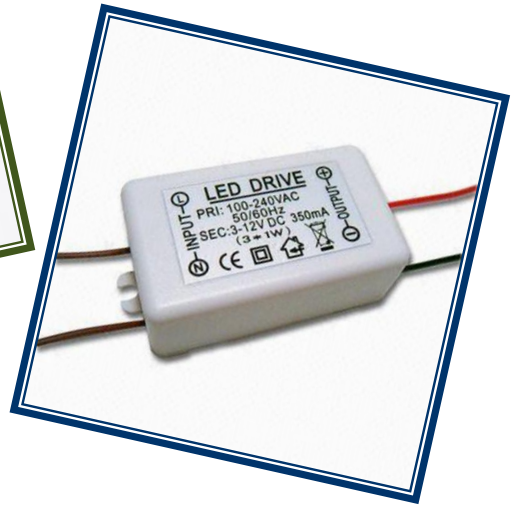
Note: LED modules are exempted from the requirements of this regulation if they are marketed as part of luminaires that are placed on the market in less than 200 units per year.

Adoption Date

Stage 1 : 1 September 2013

Stage 2 : 1 September 2014

Stage 3 : 1 September 2016



Introduction of ENERGY STAR® for Lighting

ENERGY STAR® Lamp V1.0

Finalized Aug 28, 2013

Effective Sep 30, 2014

CFL V4.3

Integral LED Lamps V1.4

Timeline:

- After May 30**, 2014**, CBs will be instructed to **stop certifying** new product submittals to CFL V4.3 and Integral LED Lamps V1.4.
- As of **Sep 1, 2014** any lamp shipped with an ENERGY STAR label must be certified to meet NEW requirements. All certifications of products to the CFL V4.3 and ILL V1.4 specifications will be invalid for purposes of ENERGY STAR qualification.

Energy Efficiency Requirements Focus

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USA

U.S. DOE

- Voluntary Label
- The DOE label enables retail buyers, utilities, and lighting professionals to evaluate solid-state lighting (SSL) product performance.

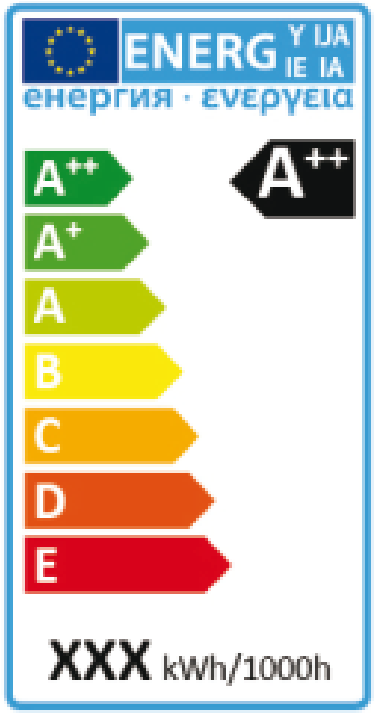
Energy Efficiency Requirements Focus

EUROPE

European Commission –

Energy Labelling

- COMMISSION DELEGATED REGULATION (EU) No 874/2012 of 12 July 2012 supplementing Directive 2010/30/EU
- Mandatory Scheme
- Energy Labelling of Electrical Lamps and Luminaires



Energy Efficiency Requirements Focus

ASIA

Hong Kong Voluntary Energy Efficiency Labelling Scheme

- Electrical and Mechanical Services Department
- Voluntary Label Scheme in 2011
- Apply to directional and non-directional LED lamps:
  a) those with a rated voltage up to 240 volts AC or DC;
  b) those with a rated frequency of 50 Hz for AC;
  c) those with a rated lamp wattage up to 60 Watts; and
  d) those with a rated CCT value from 2700K to 6500K.

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Three Major Areas

1. Safety Requirements

Countries / Programs	Electrical Safety and Performance, e.g.
North America: US/Canada	• **UL 8750: LED Equipment for Use in Lighting Products** • UL 1993: Stand for Self-Ballasted Lamps and Lamp Adapters • ANSI/UL 153: Portable Electric Luminaires • UL 1598: Luminaire • UL 153: Standard for Luminaires (Only for Portable Lighting Products)
Europe: CE Marking Directive i.e. Low Voltage Directive,	• **EN/ IEC 62031: LED Modules for general lighting-safety specifications** • EN 60968: Self-ballasted lamps for general lighting services – Safety requirements • EN/ IEC 62560:Self-ballasted LED-lamps for general lighting services by voltage > 50 V – Safety specifications • EN/ IEC 60598: Luminaries – General requirements and tests • EN/ IEC 61347: Lamp control gears – General and safety requirement • EN/ IEC 62471: Photobiological Safety of Lamps and Lamp System
International: IEC i.e. CB Safety Certification	

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Three Major Areas

2. EMC / FCC Requirements

Countries / Programs	EMC
North America: FCC	FCC Part 15: a) Radiated emission and b) Conducted emission
Europe: CE Marking Directive i.e. EMC Directive	Emission: • EN55015 : 2006 (Electrical Lighting and Similar Equipment) • EN61000-3-2 : 2006 (Public low-voltage distribution systems up to 16A current.) • EN61000-3-3 : 1995 + A1 : 2001 + A2 : 2005 (ditto) • Immunity: EN61547 : 1995 + A1 : 2000 (Applied to general lighting)
International: CISPR	CISPR 55015 (Electrical Lighting and Similar Equipment)

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Three Major Areas

3. Energy Efficiency Requirements

Countries / Programs	Photometric performance, e.g.
North America: i.e. ENERGY STAR, California Energy Commission (CEC) and Light Fact Labels	• IES LM-79-08: Electrical and Photometric Measurements of Solid-State Lighting Products • IES LM-80-08: IES Approved Method for Measuring Lumen Maintenance of LED Light Sources • IES LM-82-12: Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature.
Europe: CE Marking Directive i.e. ErP, Energy Label, Energy Saving Trust & etc.	• EN 60969: Self-ballasted lamps for general lighting services – Performance requirements (ErP directive Regulation IM 244) • Directive 2009/125/EC (EU No. 1194/2012) – Directional lamps, Light Emitting Diode Lamps and Related Equipment • Directive 2010/30/EU (EU No. 874/2012) - Energy labelling of electrical lamps and luminaires

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Three Major Areas

3. Energy Efficiency Requirements (cont'd)

Countries / Programs	Photometric performance
International: IEC - Photometric standard i.e. Efficient Lighting Initiative (ELI), Minimum Energy Performance Standard (MEPS) & etc.	• IEC 62612 Ed.1: Self-ballasted LED-lamps for general lighting service > 50V – Performance requirement • IEC/PAS 62717: LED modules for general lighting – Performance requirements • IEC/PAS 62722-1: Luminaire performance – Part 1: General requirements • IEC/PAS 62722-2-1: Luminaire performance – Part 2-1: Particular requirements for LED luminaires • IEC/EN 61341: Method of measurement of centre beam intensity and beam angle(s) of reflector lamps • IEC 62384: DC or AC supplied electronic control gear for LED modules – performance requirements

Contact

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