

Technical University of Denmark



## Test og karakterisering af LED lys

Hvilke nye standarder er på vej

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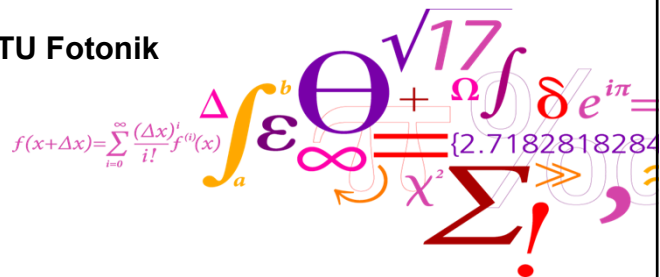
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# Test og karakterisering af LED lys

## - Hvilke nye standarder er på vej

Carsten Dam-Hansen, DTU Fotonik



DTU Fotonik  
Department of Photonics Engineering


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Department of Photonics Engineering



### Indhold

- Status for LED/SSL omkring effektivitet
- Hvorfor standarder? Og hvad kan jeg sige?
- LED lamp, luminaire test standard
  - IEA SSL Annex arbejde
  - IC2013
  - Dokumenter på vej
  - Ideel SSL verden
- Levetid?

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## Status, LED enheder

**LED enheder**  
LED package

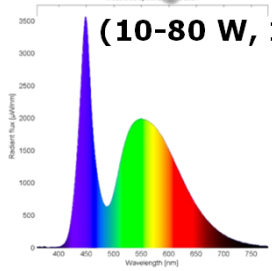
**Farvetemperatur**

2700 - 3500 K      > 5000 K

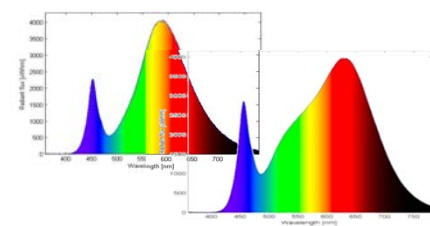
**Effektivitet:**  
123 lm @ 350 mA ~ 117 lm/W



3 mm  
(~ 1-5 W, ~1000 lm)



Measured spectral distribution  
**(10-80 W, 1500-6000 lm)**




160 lm @ 350 mA ~ 152 lm/W (@ 25 °C)  
139 lm @ 350 mA ~ 132 lm/W (@ 85 °C)

Laboratorie resultater: 303 lm/W

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## Status, SSL produkter


**SSL produkter er baseret på LED enheder**  
inkluderer optik, køleprofil og elektronik


**Retrofit produkter**

**LED lamp (cap)**

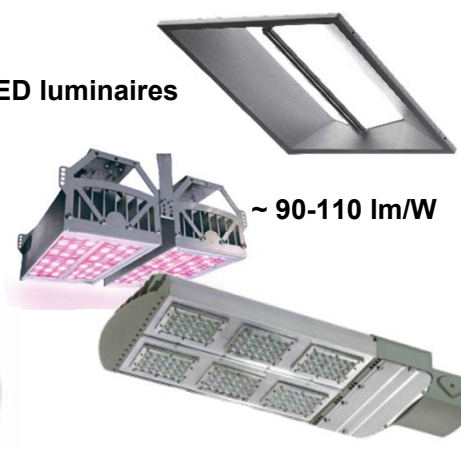


50-100 lm/W






**LED luminaires**



~ 90-110 lm/W

**LED module (no cap)**



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## Hvorfor test og standarder?

- LED og SSL er "nye" belysningsteknologier
- Det er vigtigt at realisere energibesparelser
- Regeringer har brug for standarder til brug ved regulering
- Kvalitet og holdbarhed er vigtige for bruger acceptans

### Standarder skal:

- hjælpe med implementering af nye teknologier
- hjælpe med at kunne stille krav til ydeevne
- Afhjælpe markeds barrierer
- være baseret på industriens bedste praksis, være konsistente, objektive og videnskabeligt pålidelige
- sikre målingers pålidelighed og reproducerbarhed
- Kan refereres til i lovgivning

## Hvorfor standarder?

### Hvorfor kan jeg sige noget om dette?

- Dansk medlem af CIE Div 2 "Måling på lys og stråling"
- Aktiv i CIE TC 2-71 og andre
- Dansk medlem af IEA SSL Annex
- Medlem af S-061 Lys og belysning under DS
- DTU Fotoniks nye testfacilitet / DOLL
- Bibliotek over standarder



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**Behov for international harmonisering af Test metode**

The diagram illustrates the need for international harmonization of testing methods across three major regions:

- North America:** ENERGY STAR logo, LM-79 standard, Manufacturers & Testing labs, AP for SSL test (NVLAP, etc), PT for LM-79 (NIST).
- Europe:** ENERGY STAR logo, EN T.M. standard, Manufacturers & Testing labs, AP for SSL testing, PT for EN T.M.
- Japan:** JIS T.M. standard, Manufacturers & Testing labs, AP for SSL testing, PT for JIS T.M.

Ref. Yoshi Ohno, NIST USA

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**IEA SSL Annex**


**IEA SSL Annex, 2010-2014**

Formål at levere "værktøjer" til regeringer således at de kan vurdere egenskaber af SSL produkter, harmonisere test metoder og akkreditering og derigennem skabe øget tillid til SSL produkter

Danmark er medlem igennem energistyrelsen, v. Bjarke Hansen Casper Kofod, Energy Piano, Carsten Dam-Hansen, DTU Fotonik

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### IC2013 world's largest interlaboratory comparison on SSL

- Midlertidig SSL test metode der benytter de strengeste krav og tolerancer således at alle opfyldes:
  - LM-79-08 IESNA
  - CEN/CIE Test method draft
  - IEC 62722 (LED luminaire) IEC 62612 (LED lamp) Annex A
  - JIS 7801, 8105-5 (Japan)
- Undersøge robusthed af SSL test metode igennem international laboratory comparison (IC2013)
- 5-6 forskellige typer af LED lamps
- Måle Protokol
- PPR og IR er givet til deltagende laboratorier
- Som færdighedstest ISO/IEC 17043
- Slutrapport er udgivet i går <http://ssl.iea-4e.org/>
- Generelt god overensstemmelse flux  $\pm 4\%$ , kromaticitet  $\pm 0.004$
- Vist at metoden er god undtagen for strømmålinger

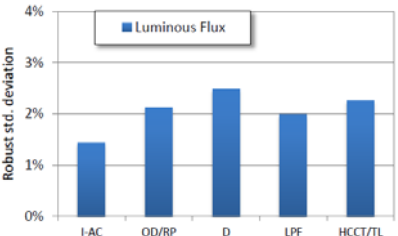
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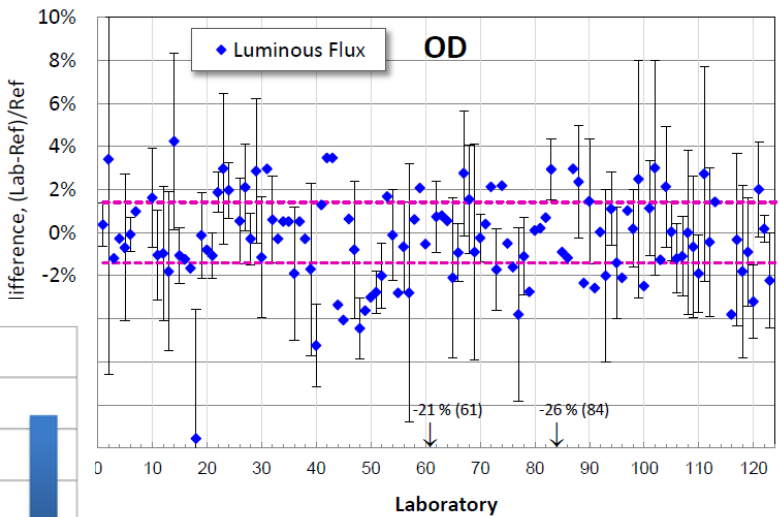
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### IC2013 world's largest interlaboratory comparison on SSL

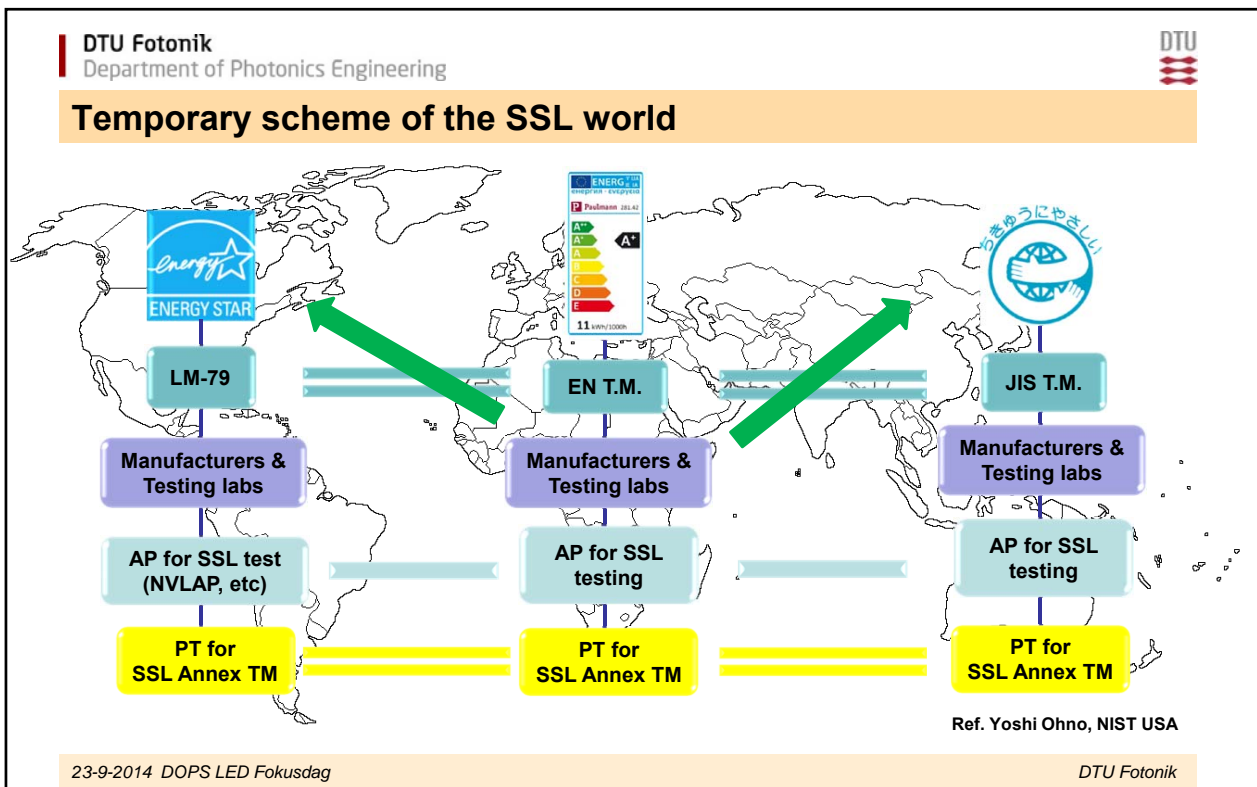
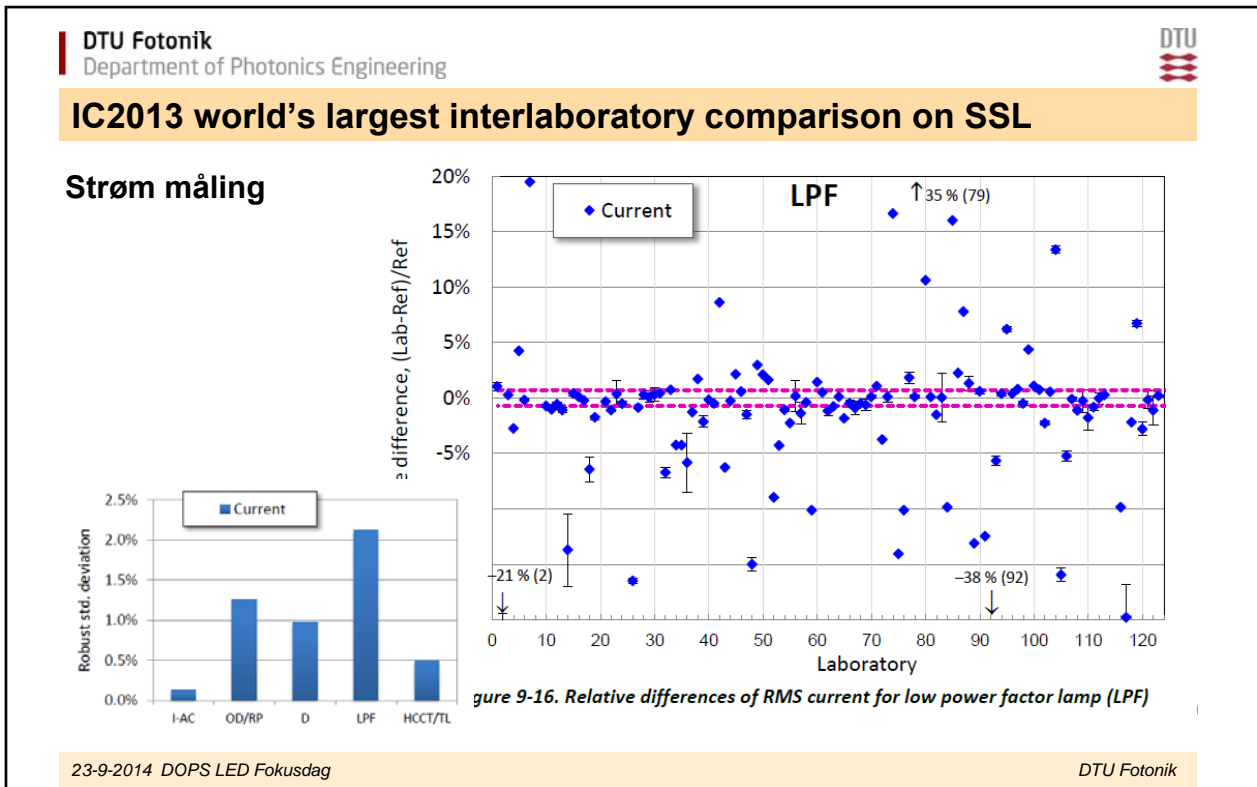
#### Lysstrøm måling





**9-2. Relative differences of total luminous flux for omnidirectional LED lamp (OD)**

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## International/europæisk Test Standard

Der er en international og en europæisk test standard for SSL produkter på vej: to arbejdsgrupper som i samarbejde udformer udkast:

**CIE TC2-71, Chair, Yoshi Ohno (US)**  
**CEN TC169 WG7, Chair, Guy Vandermeersch (BE)**

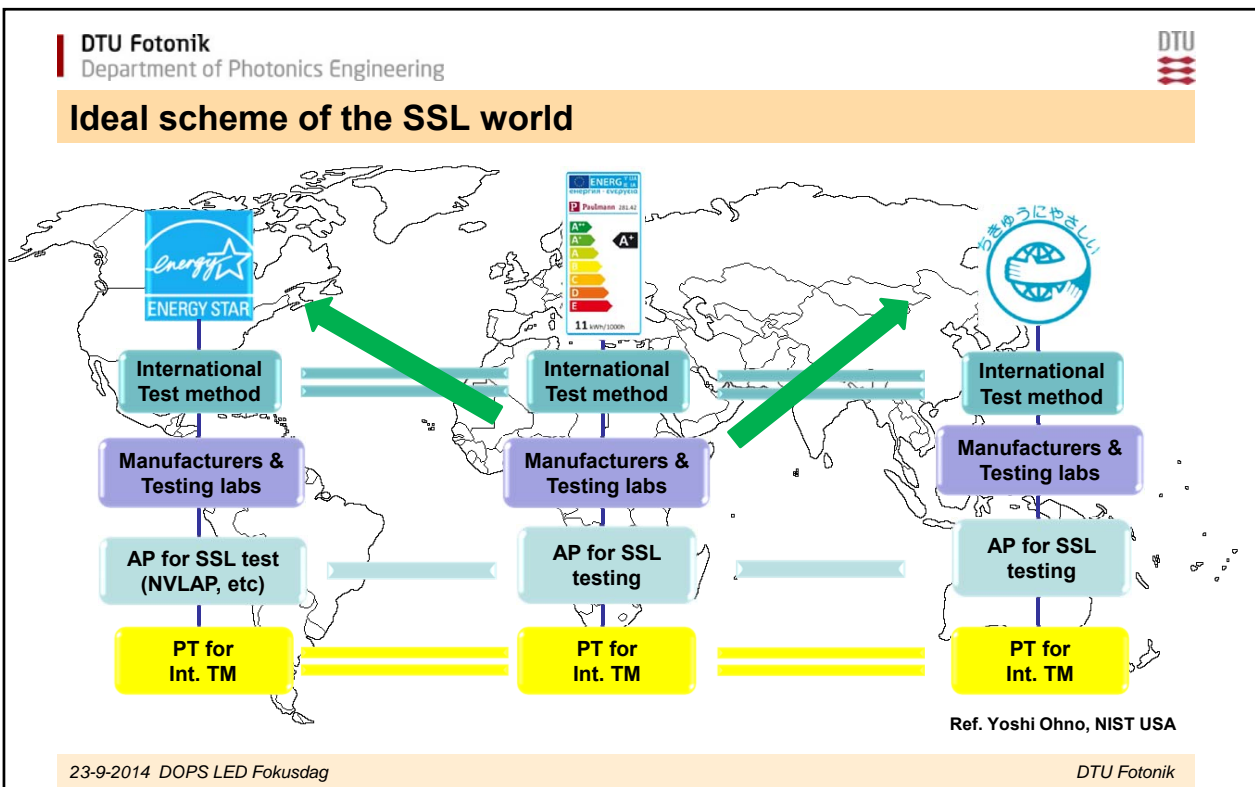
EN 13032 Lighting Applications — Measurement and presentation of photometric data of lamps and luminaires — Part 4: LED lamps, modules and luminaires

**Er til national afstemning til 24. september**

CIE D/IS 025/E:2014 Test Method for LED Lamps, LED Luminaires and LED Modules

**Udgivet den 16. september 2014**

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## International/europæisk Test Standard

Absolute photometry, Luminaire (or other SSL product) is referenced to a calibrated standard lamp

### Testing procedures

- No seasoning
- Thermal stabilization
- Ambient temperature  $25^{\circ}\text{C} \pm 1.2^{\circ}\text{C}$
- Use of integrating sphere ( $2\pi$  or  $4\pi$  setup) with spectroradiometer, or with a photometer head (sphere-photometer system)
- Use of goniophotometer with photometer head or spectroradiometer



## International/europæisk Test Standard Parametre

### Photometric:

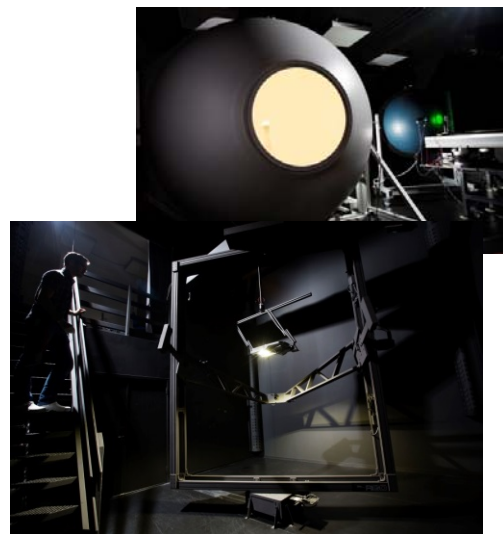
- Luminous flux [lm]
- Partial Luminous flux [lm]
- Efficacy [lm/W]
- Luminous intensity distribution [cd]

### Electrical:

- Power [W]
- Current [A]
- Power factor


### Colorimetric:

- Correlated color temperature [K], Duv
- Color rendering index
- Color coordinates...



Resultatet af målinger skal angives med usikkerhed (evt. for produkt type)

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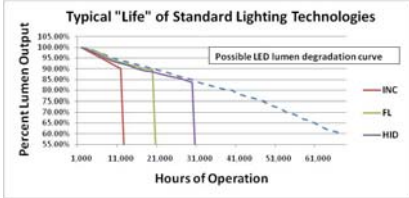


## Omkring levetid

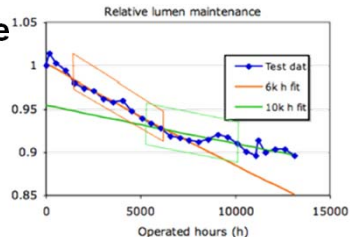
**LED fejler ikke pludseligt, men degraderer langsomt – også efter at have nået brugbar lysstrøm**

**LM-80-08 lumen and color maintenance**  
LED packages, arrays and modules  
Measurements on > 20 samples  
at 55°C , 85°C and user temperature

**TM-21-11 projection of long term lumen maintenance**  
predict estimated lumen output values at a given time duration; to interpolate lumen maintenance behaviors for the in-situ temperature  
Life notation:  $L70(6k) = 34000$  hours




Typical "Life" of Standard Lighting Technologies



Relative lumen maintenance

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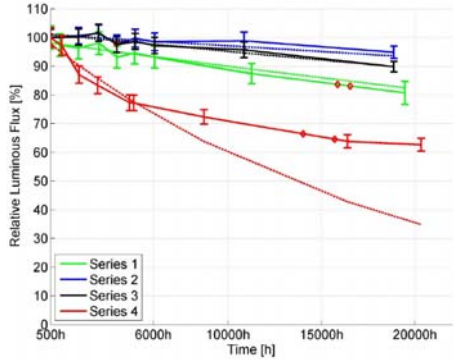
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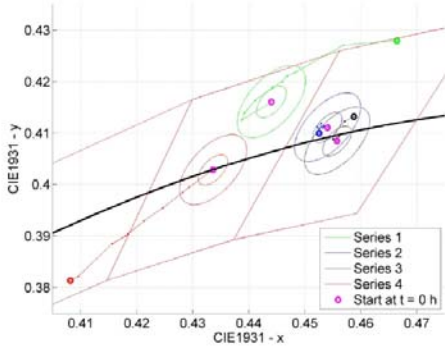
## Omkring levetid

**LM-80 og TM-21 tager ikke højde for en LED lamp med optik, køling og elektronik, som kan fejle før LEDen**

**Langtids test under LED Positivliste projektet (Elforsk)**



Relative Luminous Flux [%]



CIE1931 - y

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## Omkring levetid

**IES LM-82-12 Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature**

**LM-84-14 SSL Lumen maintenance test LED lamps, light engines, LED luminaires**

test duration <6000 hours, but  $\geq 3000$  hours

**TM-28 projection of long term lumen maintenance (draft)**  
using the new LM-80 and LM-84 testing data for projecting long-term lumen maintenance

