Testing Lamp Product Performance, and Interpreting and Using the Results

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Overview

- Guidance and recommendations on:
  - Process for testing of lighting products
  - How to interpret test results
  - How to use test results
- For single-ended, mains-voltage omnidirectional lamps used for general illumination:

Incandescent & halogen

Compact fluorescent CFLs

Light emitting diode LEDs

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Lamp Testing – Key Steps

1 → Assess national testing needs

2 → Locate test laboratory capacity

3 → Determine lamp testing procedure

4 → Select and define key test parameters

5 → Apply international standards

6 → Use correct laboratory test equipment

1 → Assess National Testing Needs

- Assess extent of testing needed to support the MVE programme
  - How large is the national lighting market?
  - What product types will the policy measure cover?
- Consider demand for testing from different stakeholders
  - How many different models and technologies are being imported?
  - Can a country of this size sustain a lighting test laboratory?

Carefully estimate the testing capacity required to support the national or regional S&L programme

2 → Locate Test Laboratory Capacity

- Three main different options for consideration :
  1. Establish local or national test facility for lighting
  2. Use independent foreign test laboratory services, such as the GELC in Beijing, China
  3. Collaborate regionally or bilaterally

National vs Regional Approach

- Advantages in soliciting testing services from regional or global partners:
  - Time saving
  - Increased competition → lower testing costs
  - Increased standards alignment potential - MVE collaboration & resource sharing
- Consider cost-effective options of “screen” or “document-based” testing

Legal implications should be considered

Case Study: Documentation Checks - Denmark

- Danish Energy Agency (DEA) has incorporated evaluation of technical documentation in MVE process since 2010
- Increased number of products inspected, without increasing total costs
- Products that failed document inspections were then targeted for laboratory testing
- Advantages include:
  - Quick and effective insight into supplier awareness of legal requirements
  - Can increase information exchange, dialogue, and cooperation
  - Expensive laboratory testing can be carried out at a lower frequency
  - Beware of product compliance on paper, but not in practice

3 → Determine Lamp Testing Procedure

Select Test Standard	• Select appropriate test standard & appropriate parameters • Acquire & prepare samples as required
Ageing (seasoning)	• Lamps aged in ageing room • Most standards do not require aging for LEDs
Initial Test	• Performed in testing room with Integrating sphere or goniophotometer to measure: electrical, photometric & colorimetric parameters
Lifetime Test	• LEDs may require much longer lifetime testing periods • Currently no lifetime test methods have been globally recognized
Lumen Maintenance Test	• Samples placed in ageing room to operate to a certain time period – e.g. 1000 hrs and/or 2000 hrs

4 → Select and Define Key Lamp Parameters

- Some key parameters:
  - Light output (total luminous flux)
  - Power consumption (or rated power)
  - Lifetime
  - Lumen maintenance
- These are the most prevalent parameters in use
- Their definition and application are well-covered, for example in the en.lighten Toolkit

5 → Apply International Standards

Products	Standards		
	IEC	CIE	IESNA
Incandescent/ Halogen	IEC 60064, IEC 60357	CIE Publication No. 13.3 (for CRI only) No 84 – 1989	LM-45
Fluorescent	IEC 60969	"	LM-66
LED	IEC/PAS 62612	*CIE DIS 025/E:2014*	*LM-79*

6 → Use Correct Laboratory Test Equipment

- Equipment for measuring luminous flux:

Integrating sphere

Goniophotometer

Each measures light output specific to a type of light source, or to design and measurement requirements

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Interpretation of Test Results

- MVE authorities use test results to:
  - Confirm compliance of products
  - Inform MVE authorities' enforcement action
- S&L policymakers use test results to:
  - Form the basis of S&L programmes

- Many contributing factors can impact the final results of a tested lamp

It is important for policymakers to have an understanding of test results and their limitations

Interpretation of Test Results: Uncertainty

"A measurement result is complete only when accompanied by a quantitative statement of its uncertainty. The uncertainty is required in order to decide if the result is adequate for its intended purpose and to ascertain if it is consistent with other similar results." *- NIST*

- Uncertainty:
  - **Type A**: variation between each measurement
  - **Type B**: variation from external factors
- Mitigated through:
  - Increased sample size, averaging results
  - Equipment selection & calibration

Reporting Uncertainty…

Typically, measurements are reported as the measured result, together with the + or – range of uncertainty figure, e.g. *'The length of the lamp is 20 cm ±1 mm.'*

Interpretation of Test Results: Uncertainty

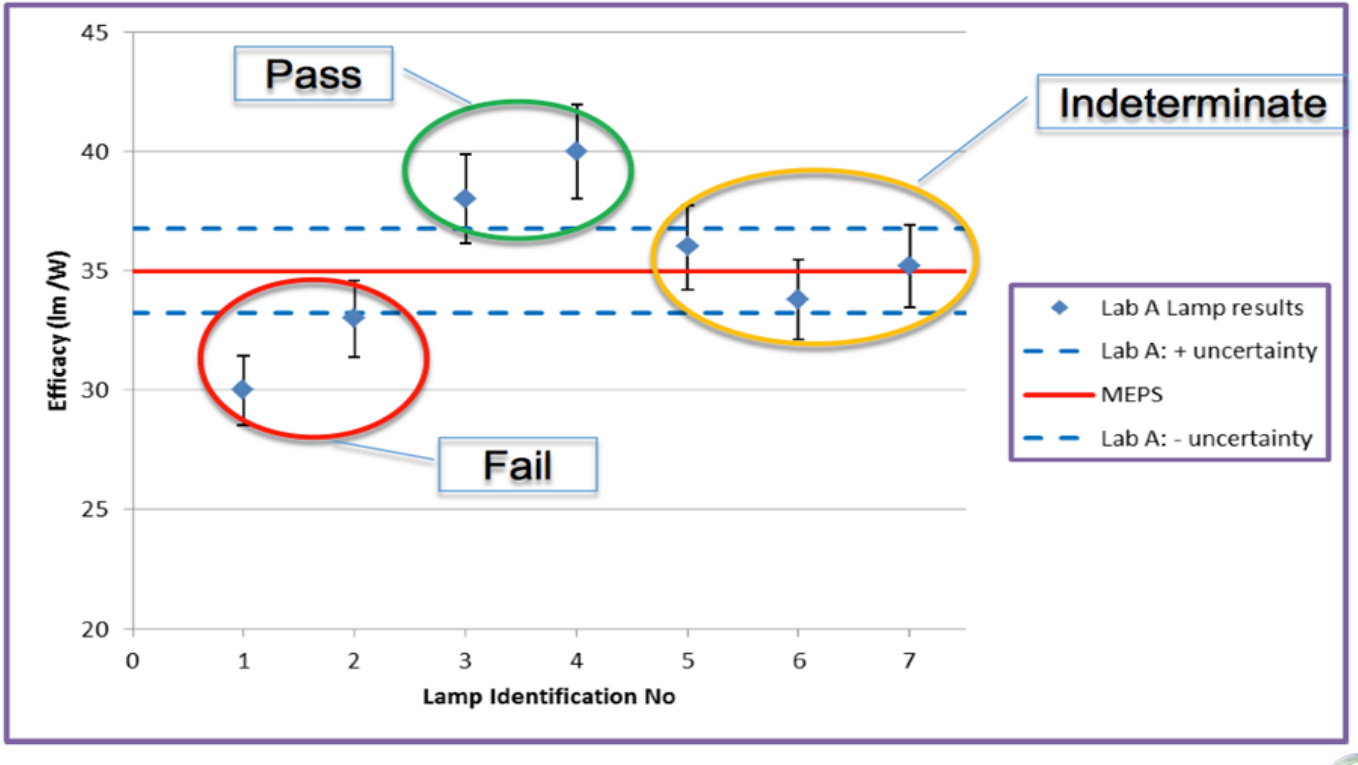
- '*Uncertainty*' and '*Error*' should not be confused:
  - *Error* - difference between measured value and 'true value' of the tested product
  - *Uncertainty* - quantification of doubt of the measurement result

Correction can be made for known errors. But any error whose value is not known is a source of uncertainty.

Interpretation of Test Results: Pass/Fail Determination

- Options to determine “pass” or “fail”:
  - Use internationally recognized convention and reporting method – ILAC G8:03/2009 “*Guidelines on the Reporting of Compliance with Specification”*
  - Apply the following simple method:
    - Define acceptance limit based on requirements
    - Assign “pass” or “fail” status by comparing all measured points to acceptance limits
    - Note uncertainty associated with measured value
  - Refer to other internationally agreed documents for detailed evaluations of uncertainty and calculations for compliance

Interpretation of Test Results: Pass/Fail Determination



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Application of Test Results: Verification

- Value of market sampling and testing:
  - Key steps to determine whether energy performance claims have been met
  - Data used to provide a picture of compliance levels and/or market data on products

There are two main forms of verification testing:

- **Screening tests**: Typically used to provide a preliminary assessment of products likely to fail a full verification test
- **Full verification tests**: Full procedure verification testing carried out in accordance with regulation is typically the process followed in support of subsequent enforcement action

Application of Test Results: S&L Development

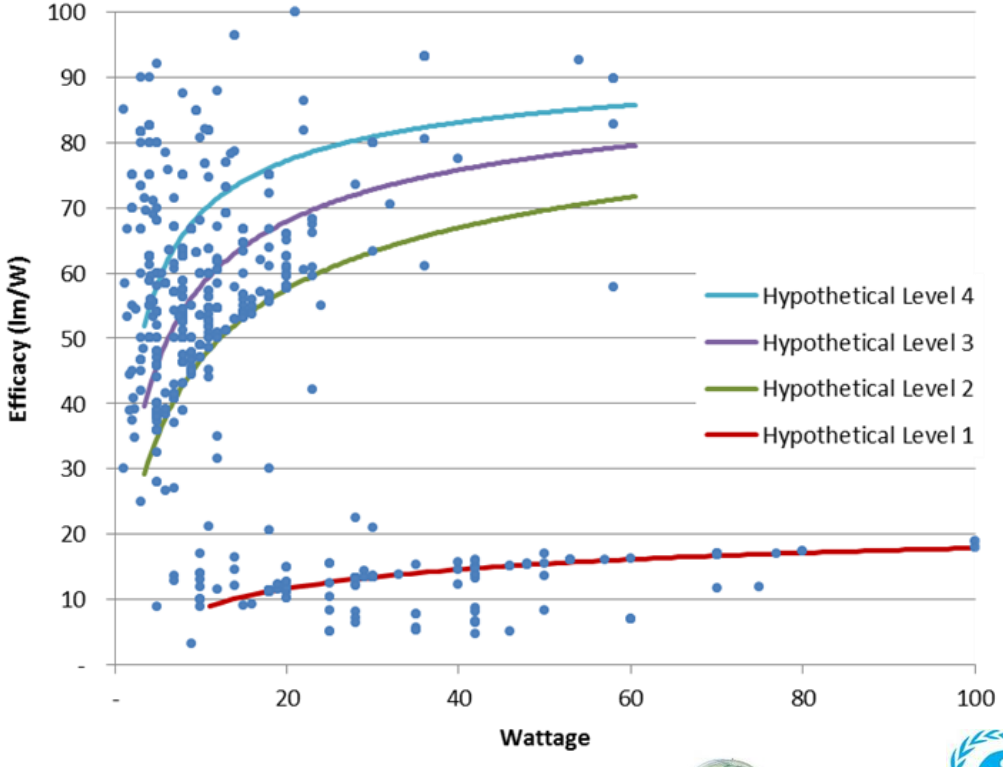
There are five general areas where product-related data can inform the MEPS process:

- Market
- Engineering
- Usage
- Behavioural
- Others

If available, the data provide a clear picture of the market and users, which can help to inform regulators on setting standard levels, and to consider how these levels could impact the market

Application of Test Results: S&L Development

In determining MEPS levels for lamps, one of the possible approaches is a continuous curve that describes the minimum required efficacy of products based on their rated power or initial flux.



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Regional Resource Sharing

- Beneficial, as a region normally shares a lot of the same or similar product models
- Ways to share resources include:
  - Establishing a regional registration database
  - Sharing test results
  - Co-ordinated MVE planning

As resources for MVE can be very limited, regional collaboration on testing for MVE is an excellent way to cost-effectively improve the impacts and outcomes of S&L programmes

Summary

- If testing capacities and capabilities are not already in place, policymakers may wish to carefully weigh alternatives
- In the ASEAN and Pacific region, alternatives exist, including the Global Efficient Lighting Centre
- Another option is to cooperate in the development of a regional resource strategically located
- Testing processes, methodologies, and parameters are all part of an integrated policy approach
- Building both physical and human capacity is essential for a successful MVE framework

Questions?

Thank you!

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