Inter-laboratory Comparison Testing for Efficient Lighting Products

Formal Confirming Report

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1. Introduction

This is under the project “Establishing the Foundations of a partnership to accelerate the Global Market Transformation for Efficient Appliances and Equipment”, and entitled “Building capacities of the national energy efficiency laboratory to perform testing of lighting technologies, in line with international standards”, which is part of the United for Efficiency Initiative (U4E). One of the activities in this project is to conduct an Inter-laboratory Comparison test (IC) with Jordan Standards and Metrology Organization (JSMO) Energy Efficient Laboratory (EEL).

The Inter-laboratory comparison (IC) tests are known to be one of the most reliable tools to assess the technical competence of a participating laboratory. This IC was conducted to investigate and understand the measurement capacities on SSL lighting products of Jordan Standards and Metrology Organization (JSMO) Energy Efficient Laboratory (EEL). Through the IC test, it is also intended to find out the potential improvements.

The IC activity was organized in compliance with ISO/IEC 17043 Conformity Assessment – General requirements for proficiency testing. The IC used the CIE S 025 – 2015 “Test Method for LED lamps, luminaires and modules” as the test method. The Global Efficient Lighting Centre (GELC) is the reference laboratory.

Table 1 shows the specification of the two types of artefacts to be used in this IC.

Table 1 Specifications of the artefacts

Identifier	Type	Rated (or nominal) value		
		Voltage	Power	CCT
NLTC-HCCT	Non-directional LED lamp (High CCT)	220 V AC	6 W	5000 K
NLTC-OD1	Omni-directional LED lamp		5 W	2700 K

The scope of measurements and comparisons consist of:

One (1) Non-directional LED lamp (High CCT), one (1) Omni-directional LED lamp:

- RMS voltage (V) and current (A)
- Electrical active power (W)
- Power factor
- Total luminous flux (lm)
- Luminous efficacy (lm/W)
- Chromaticity coordinates: x, y
- Correlated colour temperature (CCT) (K)
- Colour Rendering Index (CRI) Ra

2. Assigned Value and Data Analysis

a) Assigned Value

The artefacts were measured by GELC before shipping and after being returning from participating laboratory. The assigned values for the measurement quantities were determined as the average of the two measurements by GELC. The assigned value X is the average value of before shipping, X_1 and after being returning, (X_2)

$$X = \frac{X_1 + X_2}{2} \qquad \text{Formula (1)}$$

Where,

X_1: the value tested by GELC before delivering;

X_2: the value tested by GELC after being returning.

b) Relative Differences

The relative difference from the JSMO EEL to the assigned values is calculated by the following formulas:

For RMS Current, Active Power, Luminous Flux and Luminous Efficacy, the relative differences between the average test results of JSMO EEL and the assigned values are given by:

$$\Delta X = \frac{x - X}{X} \qquad \text{Formula (2)}$$

Where,

x : Average testing results of JSMO EEL.

For Chromaticity Coordinate (x, y), Correlated Color Temperature (CCT), Color Rendering Index (CRI), the relative differences between the average test results of JSMO EEL and the assigned values are given by:

$$\Delta X = x - X \qquad \text{Formula (3)}$$

3. Participating Laboratory Confirmation

JSMO EEL is requested to check the correctness of their own testing results showing in Table 3. Feedbacks received from JSMO EEL by 17 July 2017. With the confirmation by the JSMO EEL, GELC will develop the Inter-laboratory Comparison Analysis Report.

4. Results of Reference Laboratory Measurement

Table 2 Assigned value of the Artefacts

Identifier	Measurement results									
	Voltage (V)	Current (mA)	Active Power (W)	Power factor	Luminous flux (lm)	Luminous efficacy (lm/W)	x	y	CCT (K)	CRI (Ra)
NLTC-HCCT-19#	220.0	33.20	5.92	0.8122	499.1	84.24	0.3244	0.3322	5885	79.6
NLTC-OD1-15#	220.0	31.20	4.70	0.6854	222.9	47.37	0.4518	0.4053	2775	82.8

5. Results of Participating laboratory

Table 3 Test results of lab JSMO EEL

Identifier		Measurement results									
		Voltage (V)	Current (mA)	Active Power (W)	Power factor	Luminous flux (lm)	Luminous efficacy (lm/W)	x	y	CCT (K)	CRI (Ra)
NLTC-HCCT-19#	1st	220.02	32.93	5.887	0.8126	500.2	84.97	0.3252	0.3316	5843	80.10
	2nd	220.03	32.95	5.891	0.8126	501.2	85.09	0.3251	0.3315	5850	80.10
	3rd	220.03	32.96	5.889	0.8121	501.5	85.16	0.3250	0.3313	5856	80.10
	Ave.	220.03	32.95	5.889	0.8124	501.0	85.07	0.3251	0.3315	5850	80.10
	Uncertainty	0.10%	0.12%	0.11%	0.11%	2.06%	2.06%	0.0024	0.0024	15.1	0.49%

	(k=2)										
	ΔX	0.01%	-0.75%	-0.52%	0.0002	0.38%	0.99%	0.0007	-0.0007	-35	0.50
NLTC-OD1-15#	1st	220.01	32.37	4.687	0.6581	225.8	48.17	0.4525	0.4047	2759	83.00
	2nd	220.04	32.39	4.681	0.6569	225.1	48.09	0.4523	0.4046	2760	83.00
	3rd	220.03	32.49	4.683	0.6551	225.3	48.11	0.4523	0.4045	2761	83.00
	Ave.	220.03	32.42	4.684	0.6567	225.4	48.12	0.4524	0.4046	2760	83.00
	Uncertainty (k=2)	0.10%	0.24%	0.12%	0.28%	2.06%	2.06%	0.0024	0.0024	13.1	0.48%
	ΔX	0.01%	3.91%	-0.34%	-0.0287	1.12%	1.58%	0.0006	-0.0007	-15	0.20