INTERLABORATORY COMPARISON (ILC) PROGRAM
OF MASS STANDARDS
AMONG LEGAL METROLOGY LABORATORIES
OF ASEAN COUNTRIES

ASEAN SUPPORT

FINAL REPORT

DIRECTORATE OF METROLOGY
DIRECTORATE GENERAL OF DOMESTIC TRADE
MINISTRY OF TRADE – REPUBLIC OF INDONESIA
2009

FINAL REPORT

INTERLABORATORY COMPARISON OF MASS STANDARDS
ACCSQ WORKING GROUP ON LEGAL METROLOGY (ACCSQ-WGLM)
2008-2009

1. BACKGROUND

Based on the decision of the 7th Meeting of ACCSQ Working Group 3 on Legal Metrology which was held in Singapore on November 14th, 2006, Indonesia was appointed as the coordinator of the Interlaboratory Comparison (ILC) of mass standards among the legal metrology authorities of ASEAN countries. As coordinator, Indonesia was requested to provide the artifacts of mass standards and design and conduct the ILC Program.

This program is important for establishing and maintaining Mutual Recognition Arrangements (MRA) that are very rigorous and in part, based on comparability of measurement data between the countries concerned. Consequently, this program requires participation of ASEAN legal metrology laboratories in the program.

Moreover, the ILC of mass standards is an important program to measure and assess the competence and capability of mass laboratories by comparing measurement results among standards of participant laboratories. The mass standards selected as artifacts were the mass standards of OIML Class F2.

2. OBJECTIVES

The ILC of mass standards in the ASEAN region is performed to provide the performance data of mass laboratories in each ASEAN country. The equivalence and comparability of mass standards maintained by the legal metrology authorities or their designated organizations will be established through this program.

3. IMPLEMENTATION OF THE ILC PROGRAM

3.1. The Program Design and the Time Schedule

The ILC program of mass standards was carried out during 2008-2009. The Directorate of Metrology as the Indonesian representative organization in ACCSQ WG 3 acted as the coordinator of the program. The Directorate of Metrology provided the reference values and conducted the program.

The scope of the program included following:

a. Drafting of the ILC technical protocol, including preparation of the calibration methods and procedures;
b. Sending out invitation for participation to all ASEAN member states;
c. Providing the artifacts;
d. Calibrating the artifacts;
e. Conducting the ILC and monitoring the circulation of the artifacts;
f. Compiling and evaluating the ILC results;
g. Reporting to ACCSQ WG 3 Meetings.

A total of seven ASEAN member states finally confirmed their participation in the ILC. The ILC was done in two cycles with three participants in each cycle. The Mass laboratory of the Directorate of Metrology of Indonesia as the reference laboratory calibrated the artifacts three times, i.e. at the beginning the first cycle, end of the first cycle (and start of the second cycle) and end of the second cycle. Figure 1 illustrates the circulation of the artifacts among the participating countries.

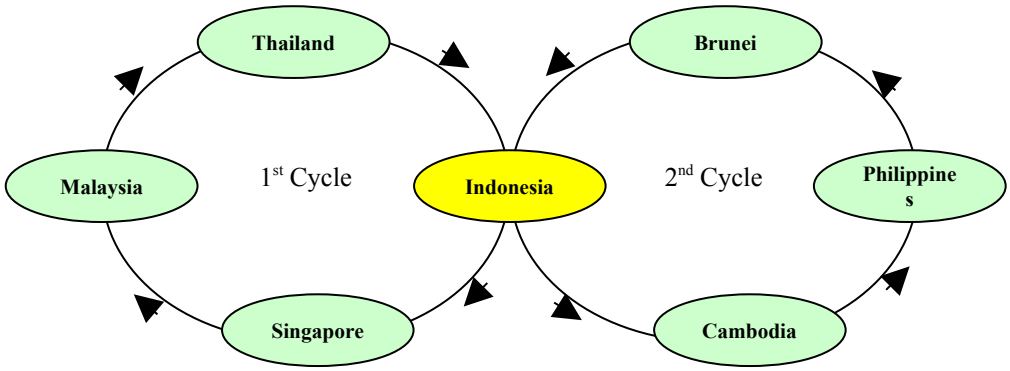

Figure 1

The complete time schedule of the ILC is as shown below:

No.	Time	Place	Activity
1.	**April 16, 2008**	**Indonesia**	Artefact calibration (Initial)
2.	May 28, 2008	Singapore	Artefact calibration
3.	June 13, 2008	Malaysia	Artefact calibration
4.	July 14, 2008	Thailand	Artefact calibration
5.	**September 11, 2008**	**Indonesia**	Artefact calibration (Middle)
6.	October 3, 2008	Cambodia	Artefact calibration
8.	January 24, 2009	Philippines	Artefact calibration
9.	Marc 4, 2009	Brunei	Artefact calibration
10.	**April 21, 2009**	**Indonesia**	Artefact calibration (Final)

3.2. ILC Participating Laboratories

The legal metrology laboratories which participated in the ILC are as listed in the table below. Some of the laboratories are designated organization of the legal metrology authorities.

No.	Country	Laboratory
1	Indonesia	National Mass Laboratory – Directorate of Metrology
2	Singapore	Weights and Measures Office SPRING
3	Malaysia	Metrology Corporation Malaysia Sdn. Bhd.
4	Thailand	CBWM – Mass Laboratory
5	Cambodia	Department of Metrology
6	Philippines	National Metrology Laboratory
7	Brunei	Calibration Centre MINDEF

3.3. Technical Protocol

Calibration methods of weight artifact, calculation techniques of measurement uncertainty, techniques of artifact handling and data sheet used in this ILC are enclosed in Appendix 1 and Appendix 2.

3.4. Artifacts

The mass standards selected for use as artifacts are OIML Class F2 standard weights with nominal values, 100 g, 200 g, 500 g and 1 kg. Figure 2 shows two pictures, one of the transportation box and another of the artifacts.

Figure 2
The Artifacts

3.5. Reference Values

The reference values for this interlaboratory comparison were–given by the Mass Laboratory of Directorate of Metrology. To define the reference value of each of the artifact, calibrations were done three times, at the start of the first cycle (April 16th, 2008), between the first and second cycles (September 11th, 2008) and at the end of the second cycle (April 21st, 2009).

As the artifacts were of class F2, they were calibrated by using reference weights of class F1.

The reference weights used were traceable to the 1 kg Platinum Iridium Prototype of Mass Standard - K46, maintained by the Mass Laboratory of Directorate of Metrology.

4. EVALUATION OF THE ILC RESULTS ~~ILC~~

Evaluation of the ILC program is referred to ISO Guide 43 "Interlaboratory Comparison's method" using the formula as follows:

$$E_n = \frac{\text{LAB} - \text{REF}}{\sqrt{U_{LAB}^2 + U_{REF}^2}}$$

Where:

LAB : Participant Laboratory's result

REF : Reference Laboratory's result

U_{LAB} : Participant Laboratory's reported uncertainty at 95%

U_{REF} : Reference Laboratory's reported uncertainty at 95%

For the results to be acceptable, values of $|E_n| \leq 1$ are required. Values of $|E_n| > 1$ will require investigation and corrective action by the laboratory concerned.

The performance analysis of the Laboratories by E_n values is as shown in Table 1. The laboratory codes assigned to the Laboratories are as follows :

Laboratory Code 1 : Departement of Metrology – Cambodia
Laboratory Code 2 : Calibration Centre Mindef – Brunei
Laboratory Code 3 : National Metrology Laboratory– Philippines
Laboratory Code 4 : CBWM - Mass Laboratory – Thailand

Laboratory Code 5 : Weights and Measures Office – SPRING - Singapore
Laboratory Code 6 : Metrology Corporation Malaysia SIRIM BERHARD

Nominal Mass (g)	E_n					
	Code of Participants					
	1	2	3	4	5	6
1000	0.15	- 0.08	- 0.07	- 0.32	- 0.40	- 0.08
500	0.25	- 0.19	- 0.17	- 0.36	- 0.04	- 0.20
200	0.13	- 0.22	- 0.22	- 0.48	- 0.37	- 0.33
100	0.13	- 0.78	- 0.71	- 1.09	- 0.24	- 0.55

Table 1

Overall, the performance of the various Laboratories was very good. However, Laboratory Code 4 may need to investigate its measurement result for the 100 g mass as the E_n value was slightly greater than 1.

Figure 3 to Figure 6 show graphically the differences between the Laboratory's results and the reference values with the vertical bars indicating the uncertainty of measurements quoted by the Laboratory for each mass value.

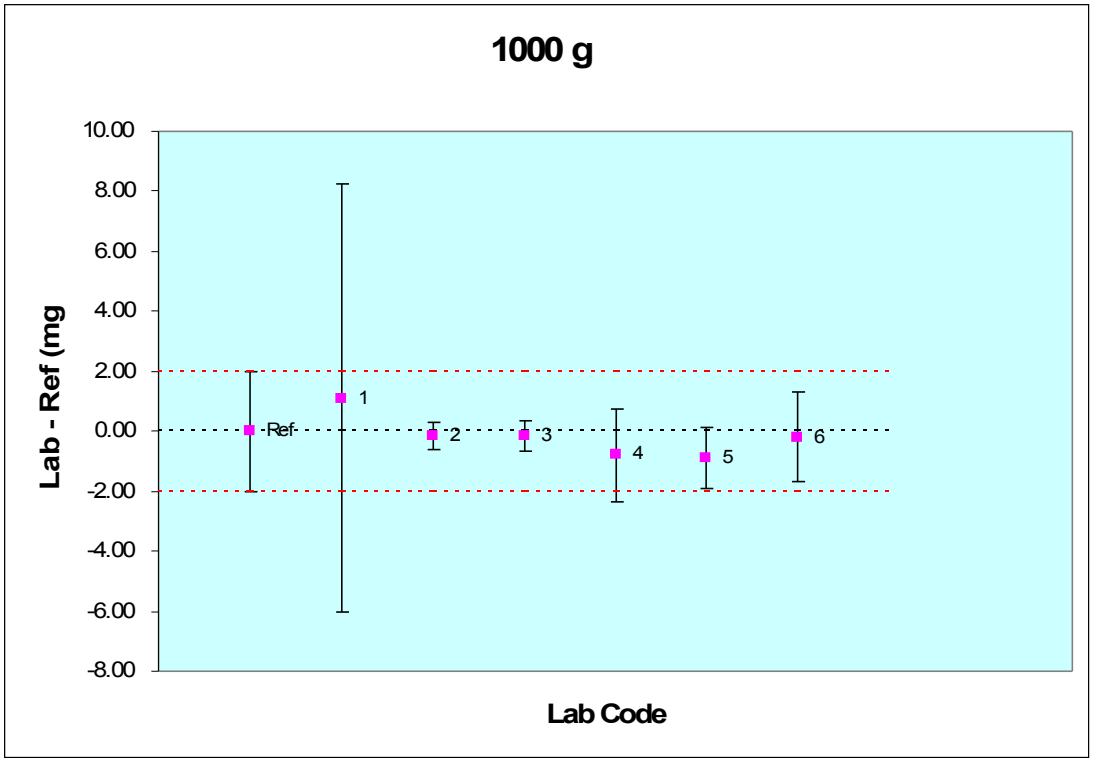

Figure 3

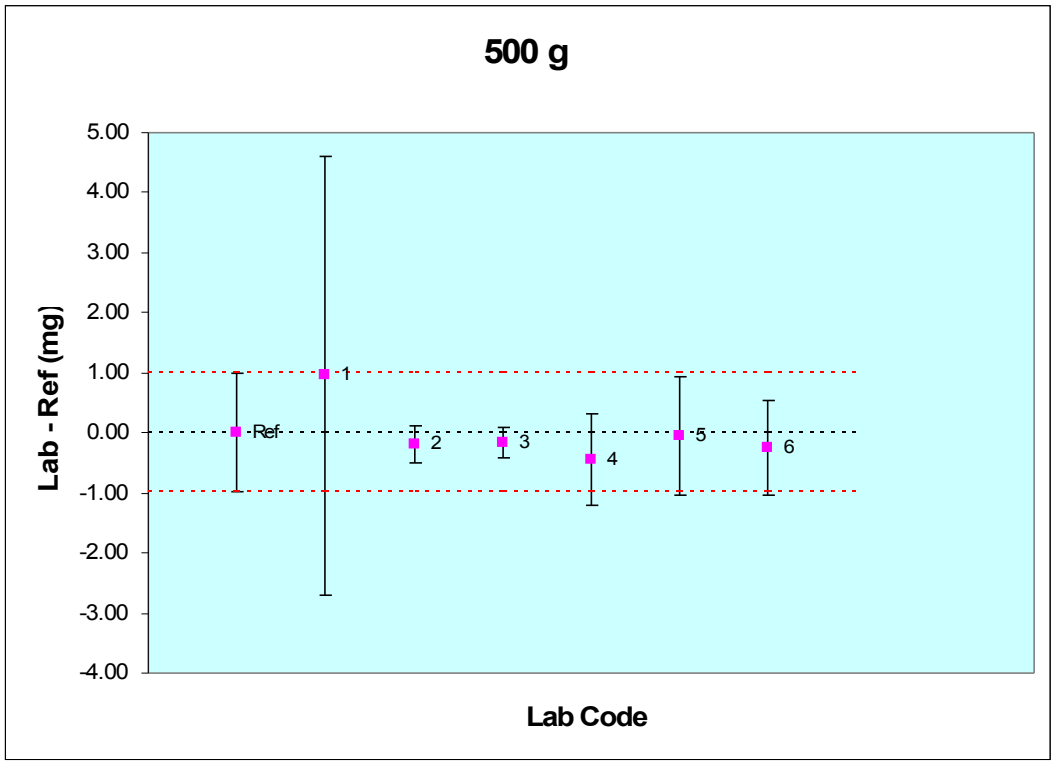

Figure 4

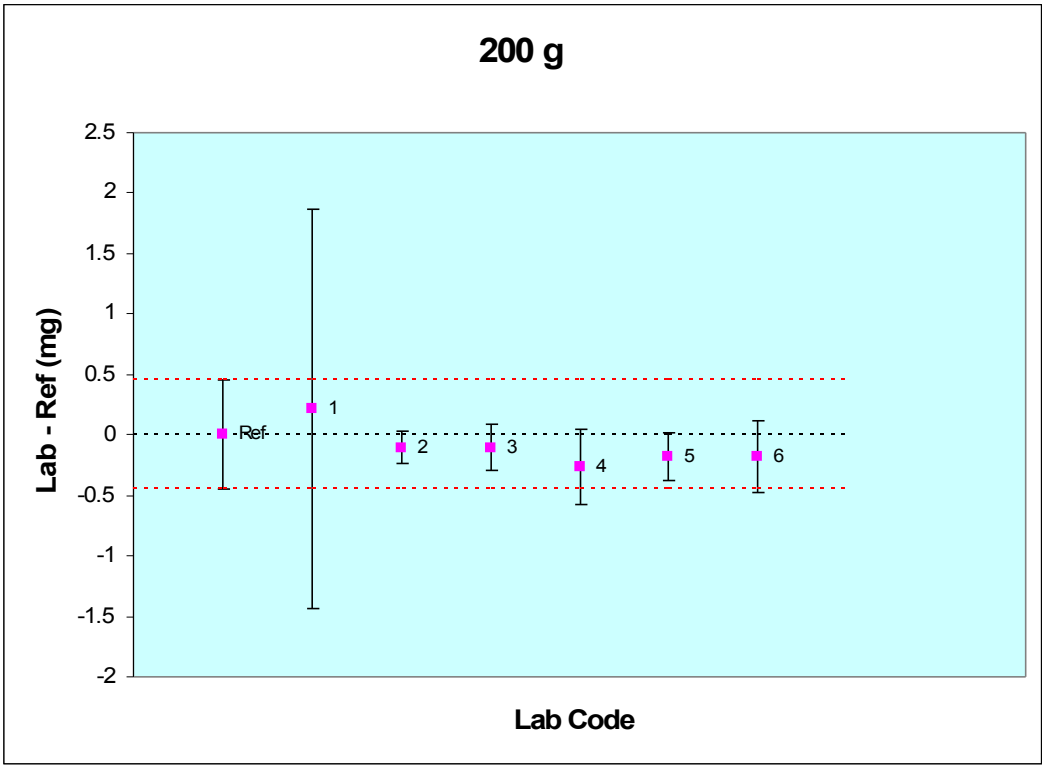

Figure 5

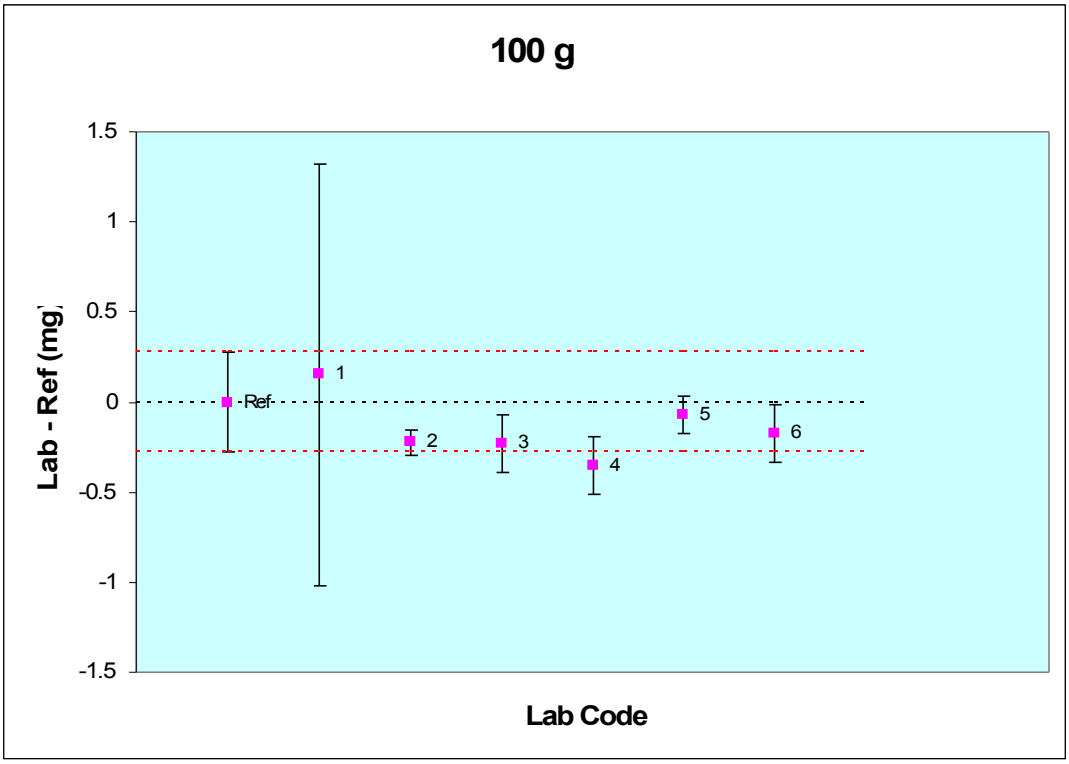

Figure 6

5. CONCLUSION

Generally, the ASEAN ILC program was successfully conducted. There were however some delays encountered which were mainly due to the customs clearance of the artifacts in some countries.

Last but not least, considering the “En” values of ~~in~~ each participant, we can conclude that, the overall performance of the participant laboratories was good.