

## DUBAI ACCREDITATION DEPARTMENT

### MASS CALIBRATION PROFICIENCY TESTING PROGRAM (PTP-185)

15 December 2010

#### 1. Introduction

Since Inter-Laboratory Comparisons (ILC) for calibration laboratories are valuable means for assessing laboratories' abilities to competently perform the prescribed calibration. ILC provides objective evidence that laboratory can achieve the level of accuracy for which it is accredited or nominated. Also provides a means for improving the quality and performance of laboratories and offers a unique chance to verify their results together with their uncertainty calculation.

Mass is a crucial quantity in the establishment of traceability for the measurements of weights, force, volume, flow, pressure and density all of which are fundamental to the testing carried out by industry.

This strengthens the confidence among the national calibration services, the confidence of the laboratory in its own measurements and the customers' confidence in the services offered by the lab.

This scheme was conducted by Dubai Accreditation Department (DAC) during June to November 2010. The report presents the results of 185 inter-laboratory proficiency calibration program involving the calibration of mass by laboratories.

#### 2. Program Features and Design

##### 2.1 The Program

This program is part of the Inter-laboratory Comparison Programs organized by Dubai Accreditation Department (DAC) of Dubai Municipality (DM) for monitoring the validity of calibration results of laboratories operating in Dubai as a requirement of the Law No.2/2010 and ISO/IEC 17011: 2004.

##### 2.2 Code Number

Each laboratory was allocated a unique code number for the program to ensure confidentiality of results. Reference to each laboratory in this report is by code number only.

##### 2.3 Instructions

Laboratories were provided with the "Instructions to Participants" and "Results Sheet" (refer Appendix C).

##### 2.4 Artefacts

Participants were provided with one set of stainless steel integral masses. The weights were manufactured according to the OIML specification of class F2 with nominal values of 0.1g, 2g, 20g, and 500g.

##### 2.5 Participant

Seven private laboratories from Dubai participated in the program. The participant laboratories are accredited and/or registered by DAC.

##### 2.6 Pilot/Reference laboratory

Mettler Toledo calibration laboratory was given the function of the reference laboratory (RL), the laboratory is accredited by the Swiss Accreditation Service (SAS) and its accreditation number SCS 032, SAS is one of the signatories to the EA Multilateral Agreement for the recognition of calibration

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certificates. The four weights were calibrated at Mettler Toledo before and after circulation to the participants

### 2.7 Task

The task for the inter-comparison was the determination of the *Conventional Mass*  $c m$  or the *Conventional Mass error of the weight with respect to the nominal value*  $\Delta m_c$  of the four weight pieces.

### 2.8 Calibration Method:

The standard calibration procedure substitution weighing method with air buoyancy correction according to OIML R111-1:2004 was used by the reference laboratory and the participants, and accredited best measurement capability (BMC) should be used. The result, of the conventional mass and the uncertainty of the calibration had to be presented like in a regular calibration certificate.

## 3. Reporting of results by Participants

Laboratories were asked to report their test results on a proforma *Results Sheet* (Refer Appendix D). The participating laboratories were asked to report uncertainties in 95% confidence levels. Lab 87 is not facilitated for 100mg and 2g masses, and only reported results for 20g and 500g.

Results (as reported by participants) with corresponding summary statistics are presented in the tables below for each testing point for each laboratory (Appendix A).

DAC has to evaluate the results and issuing the final report which will be published on its website and communicated to the participants.

## 4. Evaluation of Laboratory Performance

The conventional mass and the uncertainties ( $k = 2$ ) of the four weights as estimated by Mettler Toledo 'before' and 'after' together with results of the participants are summarised in the Appendix A. which is showing the inter-laboratories comparison and reflect the performance of the laboratories.

The evaluation is based on matching and comparison with reference values by means of  $E_n$  ratio. For all results the value has been calculated as per the formula:

$$E_n = \frac{Lab - Ref}{\sqrt{(U_{Lab})^2 + (U_{Ref})^2}}$$

Where Ref is average of the 'before' and 'after' values measured by **Mettler Toledo (MT)**,  $U_{Lab}$  is the laboratory's reported uncertainty of measurement at 95% confidence level (according to accredited BMC), and  $U_{Ref}$  is the uncertainty reported by Ref at a 95% confidence level.  $U_{Ref}$  is the estimated from the uncertainty associated with **MT** 'before' and 'after' measurement results.

For all results the  $E_n$  value (the standardize deviation) has been calculated, a result to be acceptable the  $E_n$  ratio (also called  $E_n$  number) should be between -1 and + 1 i.e. less than 1 (the closer to zero the better performance).

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Also the uncertainty associated with stability of the weights during the period of the 'before' and 'after' measurements should be added to the measured uncertainties. The uncertainty of stability is estimated from the formula:

$$u_{\text{stability}} = \sqrt{\frac{(\text{Ref}_{\text{before}} - \text{Ref}_{\text{after}})^2}{12}}$$

As changes were within the uncertainties values 'before' and 'after' indicate that the masses and the transfer standards were considered to be stable for this comparison.

### 5. Reference Values

The reference values for the masses are the average of the 'before' and 'after' values, which were carried out by **Mettler Toledo (MT)** calibration laboratory as (RL) at the beginning and the end of the program.


The calibration performed for weights 0.1g, 2g, 20g, and 500g was appropriate for an **OIML** class **F2** on the basis of weightings made in air against standards of known mass and density.


The mass changes of the four transfer standards were the differences in mass values measured by Pilot/Reference Laboratory (RL) before (1 June 2010 and after 8 November 2010), the comparison and the changes are shown in the table below:

Nominal Value	Average Deviation (mg)	Average Conventional Mass(g)	Average Uncertainty (mg)
100 mg	-0.013	0.099988	0.010
2 g	0.035	2.000035	0.017
20 g	-0.091	19.999909	0.087
500 g	0.2	499.9998	0.34

### 6. Summary of Result

Appendix A is summarizing the results of the participating laboratories, compared with results reported by Mettler Toledo (MT) as a Reference Laboratory (RL).

Also the result of each laboratory and the reference values are plotted on graphic plots (Appendix B. This mark  is used to represent each laboratory's result on the graphs, the bars above and below the mark

 is representing the uncertainty measurements reported by the participant laboratories.

These plots are an illustration for the data and providing general comparison of results/uncertainties of participants, therefore, the evaluation of laboratory's result is based on  $E_n$  values as mentioned below. Also the error values of the participants are compared with maximum permissible errors for weights ( $\pm \delta m$  in mg) as tabulated in OIML – R111-1:2004 and the result of participants are within the permissible limits Appendix C.

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### 7. Evaluation of Participants

After estimation and evaluation of  $E_n$  values which are listed below in summary of the results Appendix A. Also the results are displayed in graphical plots with bars displaying the uncertainty ( $k=2$ ) appendix B, where, Lab 97 is out of the scale for weights 20 g and 500 g and Lab 98 is out of scale for 20 g only.

The values of  $E_n$  number for the following laboratories are larger than  $\pm 1$  and they are outside the acceptable limits  $\pm 1$ , and consequently these laboratories are outlier. The below mentioned laboratories are requested to investigate the root cause of the outlier results, implement appropriate corrective action and a report shall be available for reviewing/checking by assessment team during the nearest assessment visit.

### Outlier Laboratories:

Lab	$E_n$ Values			
	100 mg	2 g	20 g	500 g
Lab IN03	3.87	-1.22		
Lab 98	1.96	1.05	15.93	4.37
Lab 97	1.2	-2.0	-113.9	-469.75
Lab 16		-1.02		
Lab 87	Not measured	Not measured	-1.25	13.06

### 8. Technical Notes:

Outlier results of some laboratories, possibly, due to one or more of the following technical reasons:

- 8.1 Uncertainty/uncertainty budget is not correctly calculated and outlier participants should recalculate their uncertainty values
- 8.2 The laboratory is not facilitated for calibrating class F2 weights and consequently appropriate scales were not used.
- 8.3 The environment of measurement (temperature; humidity ...ect) was not controlled and/or not taken in the consideration.

**MASS CALIBRATION PROFICIENCY TESTING PROGRAM (PTP-185)  
APPENDIX A: SUMMARY OF RESULT VALUES IN DETAIL**

**100 mg**

S. No.	Lab Code	Reference Lab			Participant lb			Central	Error	OIMLF1+ve	OIMLF1-ve
		Reading	(+)ve $u_{rf}$	(-)ve $u_{rf}$	Reading	$u_{lab}$	En				
2	Lab 16	0.0999880	0.000010	-0.000010	0.100000	0.000120	0.10	0	0.0000120	0.0500000	-0.0500000
3	Lab IN03	0.0999880	0.000010	-0.000010	0.100040	0.000009	3.87	0	0.0000520	0.0500000	-0.0500000
4	Lab IN04	0.0999880	0.000010	-0.000010	0.100026	0.000089	0.43	0	0.0000380	0.0500000	-0.0500000
5	Lab 49	0.0999880	0.000010	-0.000010	0.100000	0.000012	0.77	0	0.0000120	0.0500000	-0.0500000
6	Lab 98	0.0999880	0.000010	-0.000010	0.100050	0.000030	1.96	0	0.0000620	0.0500000	-0.0500000
7	Lab 97	0.0999880	0.000010	-0.000010	0.100000	0.000000	1.20	0	0.0000120	0.0500000	-0.0500000

**2 g**

S. No.	Lab Code	Reference Lab			Participant lb			Central	Error	OIMLF1+ve	OIMLF1-ve
		Reading	(+)ve $u_{rf}$	(-)ve $u_{rf}$	Reading	$u_{lab}$	En				
2	Lab 16	2.000340	0.000170	-0.000170	1.999900	0.0001300	-1.02	0	-0.0001340	0.1200000	-0.1200000
3	Lab IN03	2.000340	0.000170	-0.000170	2.000020	0.0000200	-1.22	0	-0.0000320	0.1200000	-0.1200000
4	Lab IN04	2.000340	0.000170	-0.000170	2.0001100	0.0001020	0.73	0	0.0000760	0.1200000	-0.1200000
5	Lab 49	2.000340	0.000170	-0.000170	2.0000200	0.0000210	-0.52	0	-0.0000140	0.1200000	-0.1200000
6	Lab 98	2.000340	0.000170	-0.000170	2.0001200	0.0000800	1.05	0	0.0000860	0.1200000	-0.1200000
7	Lab 97	2.000340	0.000170	-0.000170	2.0000000	0.0000002	-2.00	0	-0.0000340	0.1200000	-0.1200000

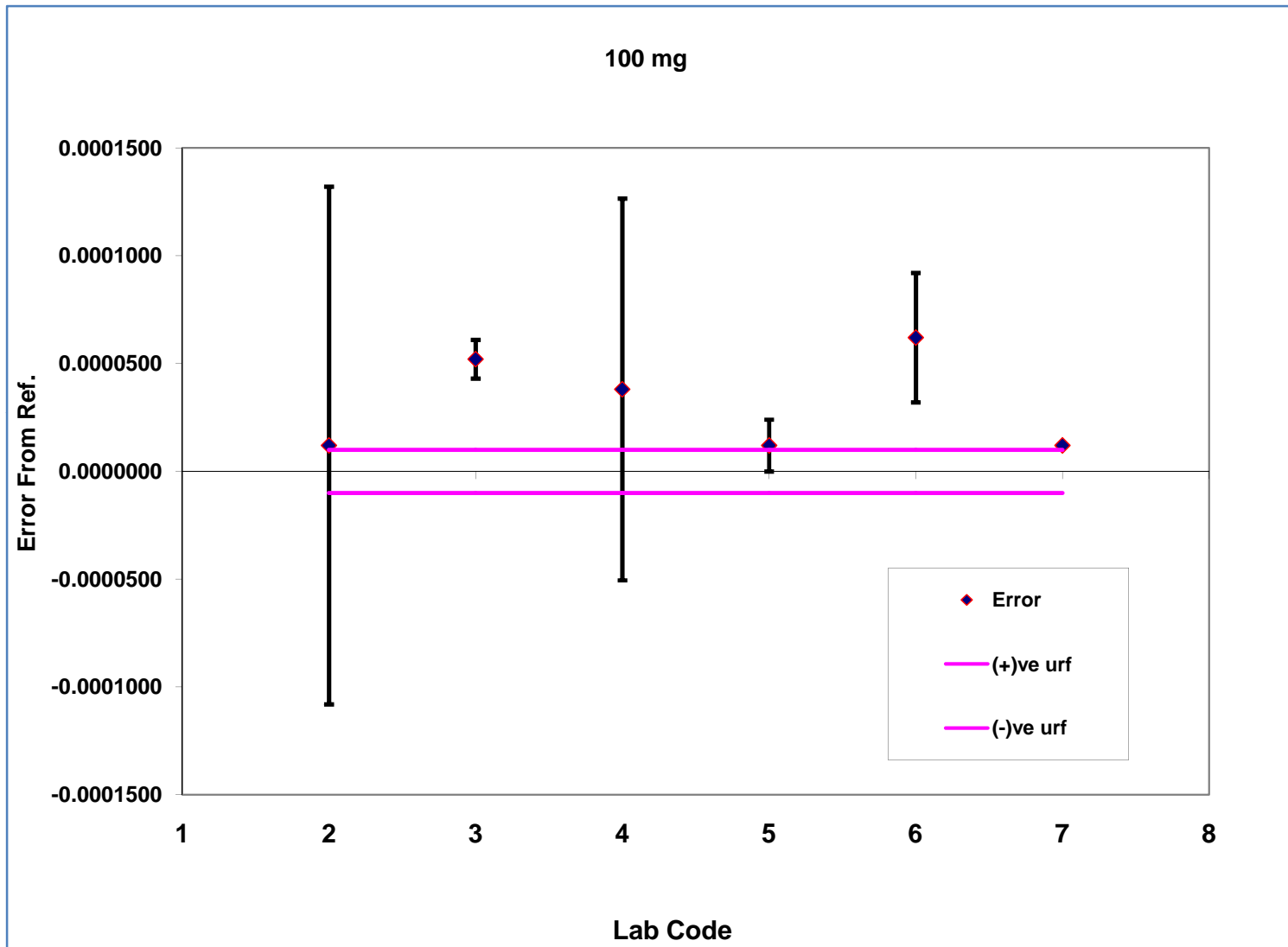
**20 g**

S. No.	Lab Code	Reference Lab			Participant lb			Central	Error	OIMLF1+ve	OIMLF1-ve
		Reading	(+)ve $u_{rf}$	(-)ve $u_{rf}$	Reading	$u_{lab}$	En				
2	Lab 16	19.9999090	0.0000870	-0.0000870	19.9999000	0.0001400	-0.05	0	-0.0000090	0.2500000	-0.2500000
3	Lab IN03	19.9999090	0.0000870	-0.0000870	19.9999800	0.0000400	0.74	0	0.0000710	0.2500000	-0.2500000
4	Lab IN04	19.9999090	0.0000870	-0.0000870	20.0000460	0.0001990	0.63	0	0.0001370	0.2500000	-0.2500000
5	Lab 49	19.9999090	0.0000870	-0.0000870	19.9999100	0.0000400	0.01	0	0.0000010	0.2500000	-0.2500000
6	Lab 98	19.9999090	0.0000870	-0.0000870	20.0020000	0.0001000	15.78	0	0.0020910	0.2500000	-0.2500000
7	Lab 97	19.9999090	0.0000870	-0.0000870	19.9900000	0.0000004	-113.90	0	-0.0099090	0.2500000	-0.2500000
8	Lab 87	19.9999090	0.0000870	-0.0000870	19.9998000	0.0000003	-1.25	0	-0.0001090	0.2500000	-0.2500000

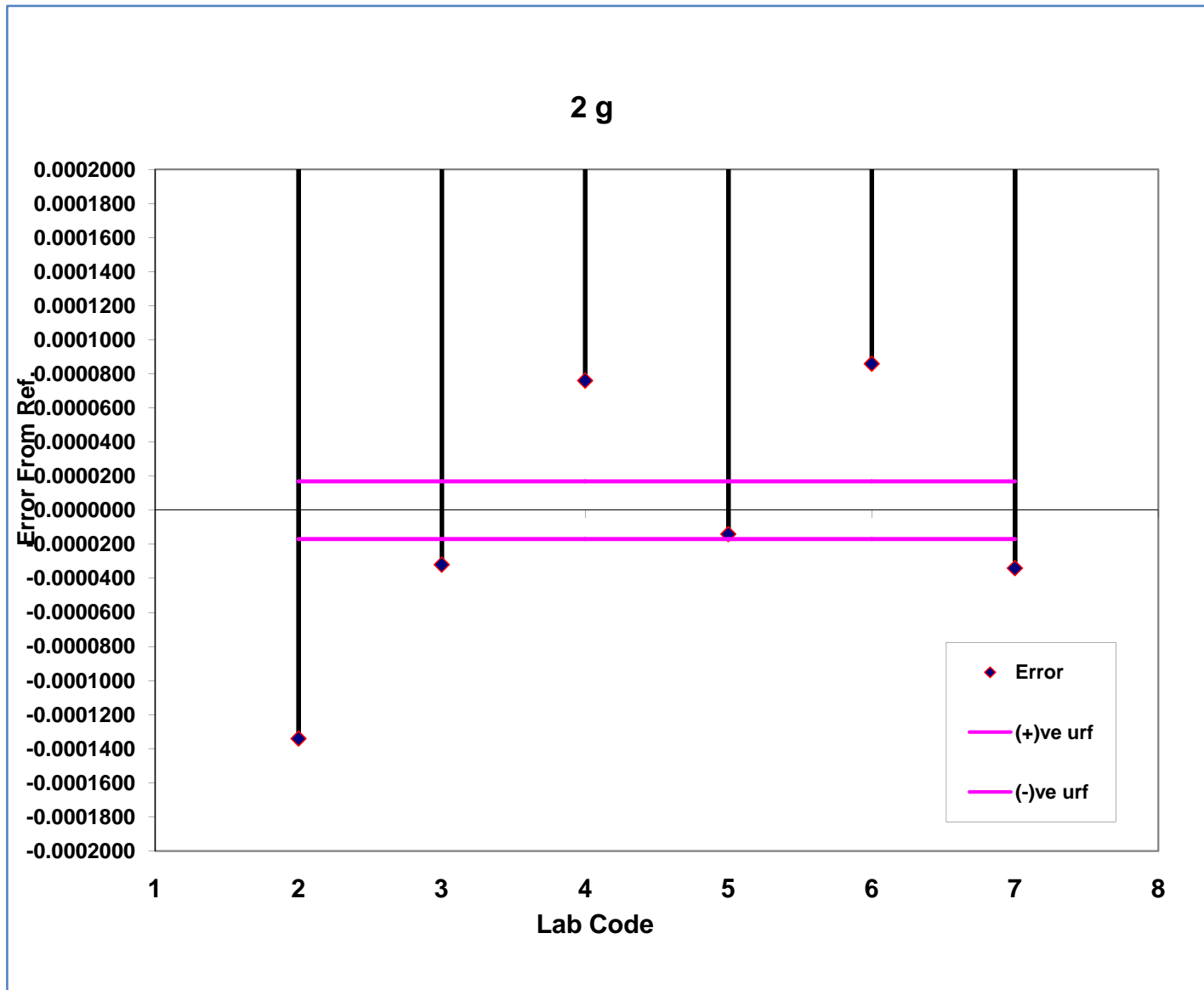
**500 g**

S. No.	Lab Code	Reference Lab			Participant lb			Central	Error	OIMLF1+ve	OIMLF1-ve
		Reading	(+)ve $u_{rf}$	(-)ve $u_{rf}$	Reading	$u_{lab}$	En				
2	Lab 16	499.9998600	0.0003400	-0.0003400	500.0000000	0.0082000	0.02	0	0.0001400	2.5000000	-2.5000000
3	Lab IN03	499.9998600	0.0003400	-0.0003400	500.0001000	0.0083000	0.03	0	0.0002400	2.5000000	-2.5000000
4	Lab IN04	499.9998600	0.0003400	-0.0003400	500.0071600	0.0123800	0.59	0	0.0073000	2.5000000	-2.5000000
5	Lab 49	499.9998600	0.0003400	-0.0003400	500.0000000	2.0000000	0.00	0	0.0001400	2.5000000	-2.5000000
6	Lab 98	499.9998600	0.0003400	-0.0003400	500.0025000	0.0005000	4.37	0	0.0026400	2.5000000	-2.5000000
7	Lab 97	499.9998600	0.0003400	-0.0003400	499.8400000	0.0000144	-469.75	0	-0.1598600	2.5000000	-2.5000000
8	Lab 87	499.9998600	0.0003400	-0.0003400	500.0043000	0.0000030	13.06	0	0.0044400	2.5000000	-2.5000000

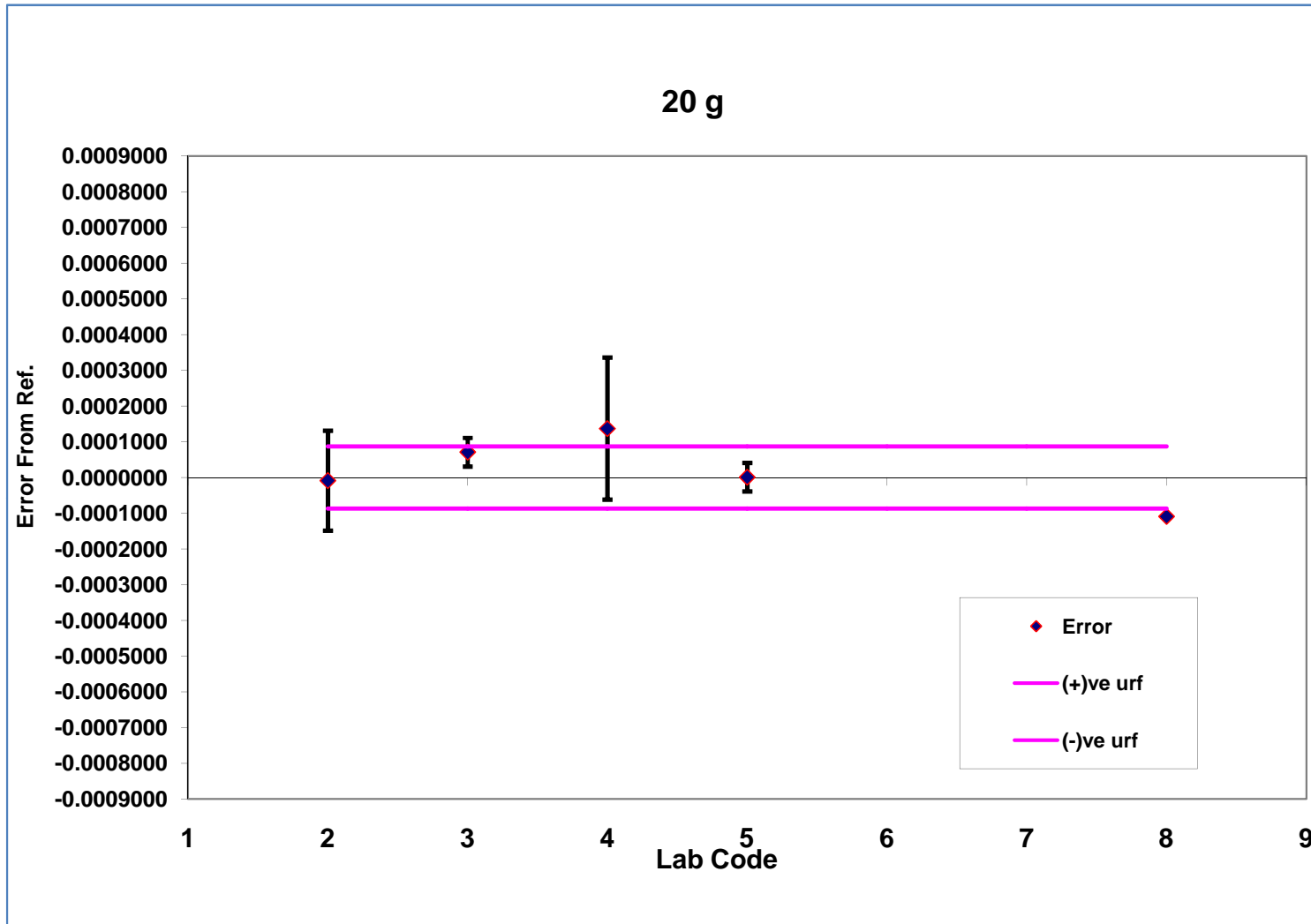
APPENDIX B  
PARTICIPANT'S RESULTS AND REFERENCE VALUES PLOT



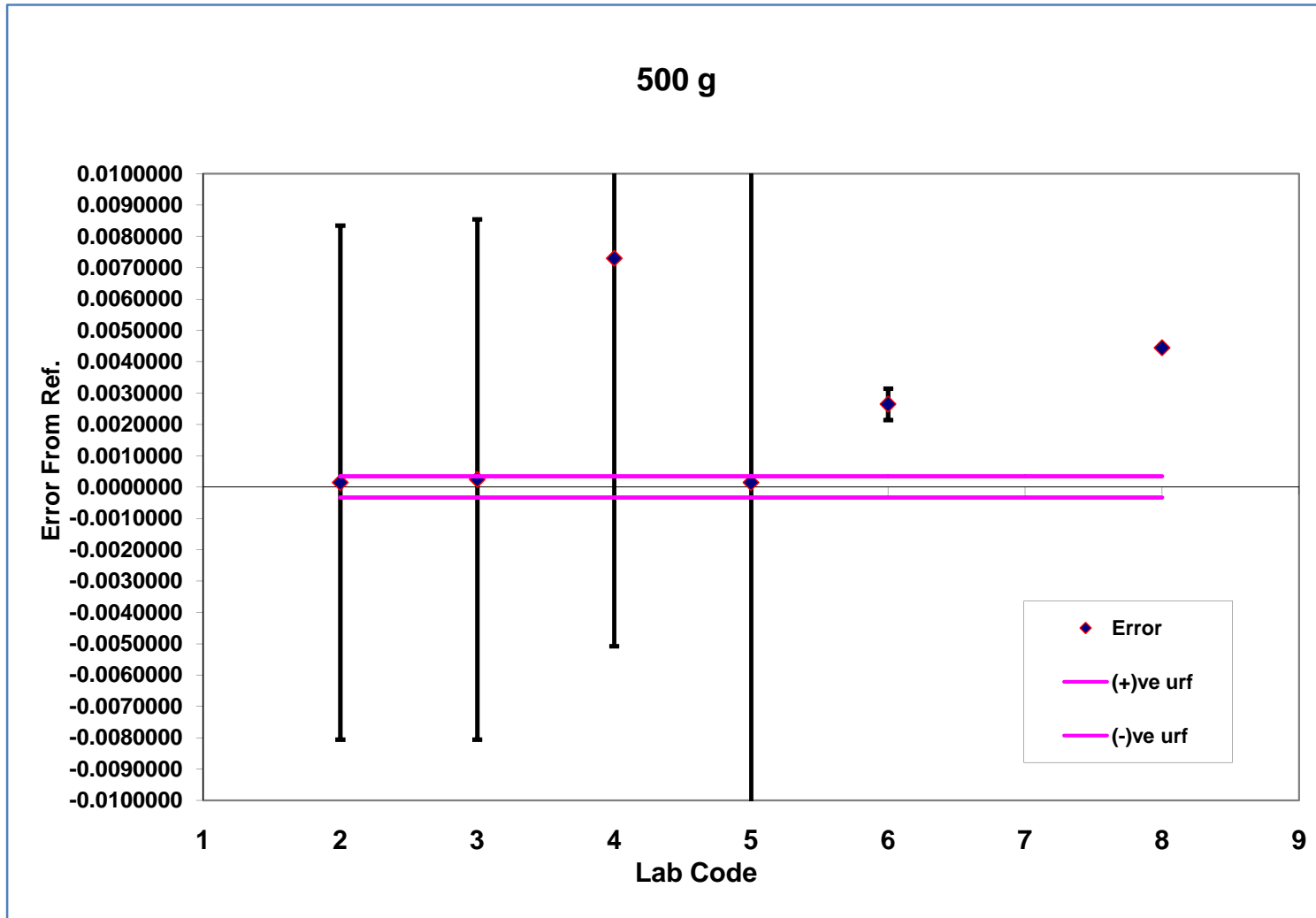
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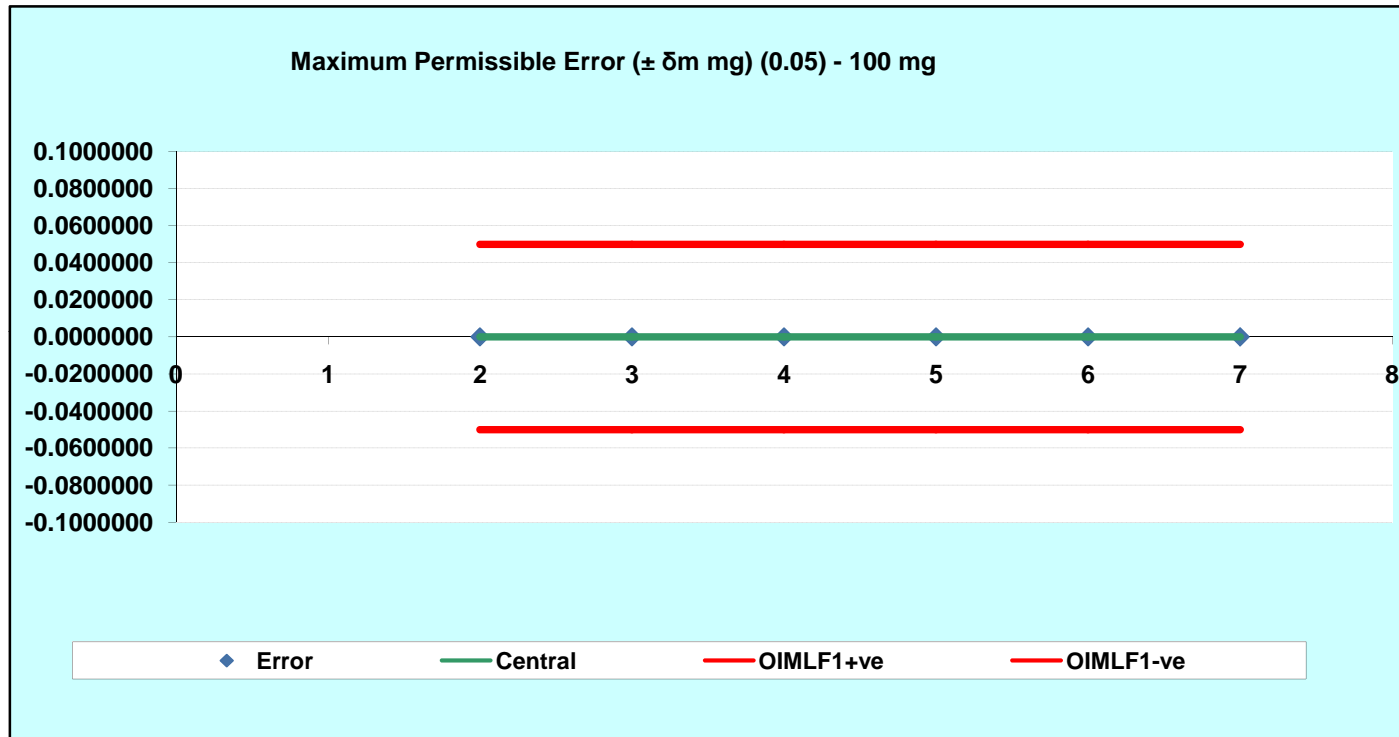


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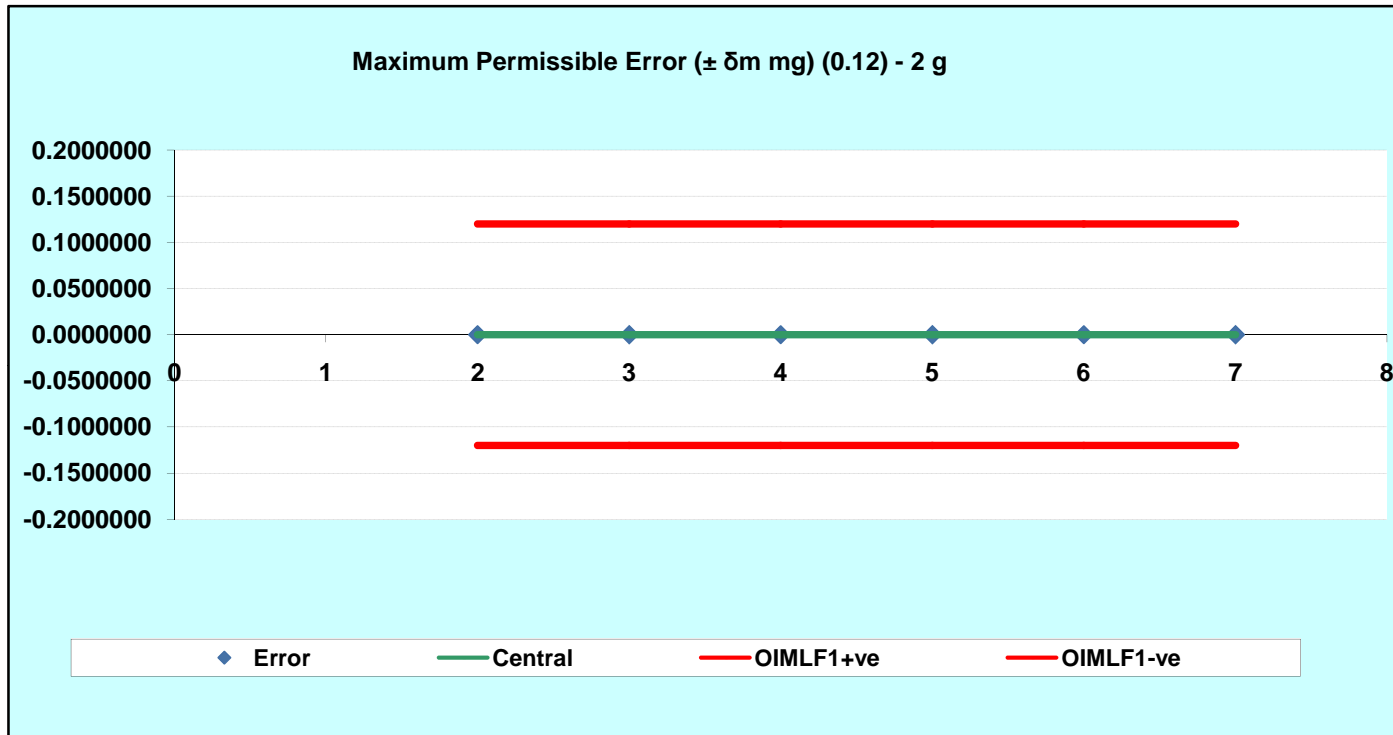
## APPENDIX C

### COMPARISON OF PARTICIPANT'S RESULTS WITH OIML MAXIMUM PERMISSIBLE ERRORS FOR WEIGHTS PLOT



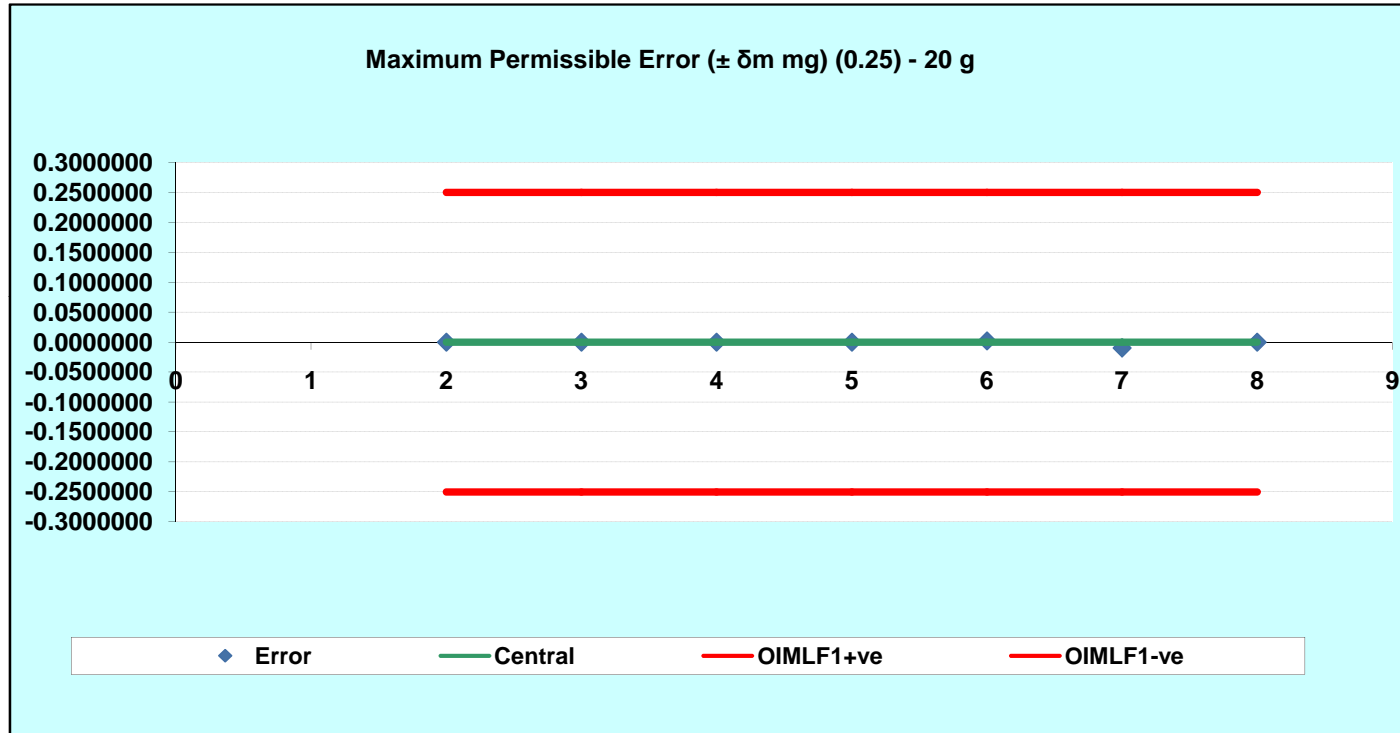
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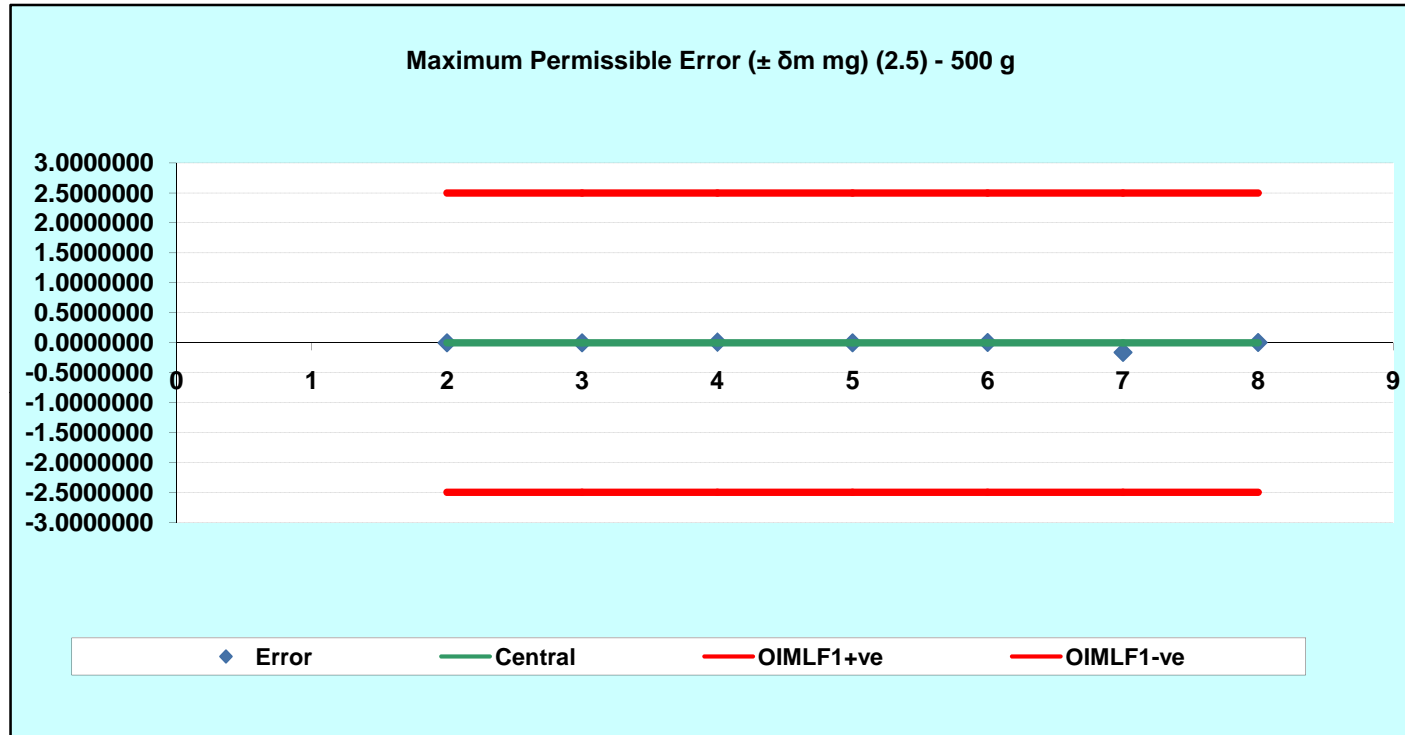
## APPENDIX C

### COMPARISON OF PARTICIPANT'S RESULTS WITH OIMLF MAXIMUM PERMISSIBLE ERRORS FOR WEIGHTS PLOT



## APPENDIX C

### COMPARISON OF PARTICIPANT'S RESULTS WITH OIML MAXIMUM PERMISSIBLE ERRORS FOR WEIGHTS PLOT



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### APPENDIX D INSTRUCTIONS TO PARTICIPANTS

#### General:

- DAC organize This PTP to give organizations an opportunity to demonstrate their proficiency in the calibration of Masses. By participating, participants will demonstrate technical competence for the measurement of parameters associated with determining the mass of an object. Associated reported uncertainties will also be evaluated as part of this PTP.
- *Participant agrees to tolerate by all instructions as a condition of their participation in this PTP. Breakdown to follow all instructions will result in participant being responsible for any replacement costs caused by failure to stick on to instructions, including but not limited to damage to artifact, loss of artifact and/or delay in measurement process*

#### Artifact:

- 4 Stainless steel integral masses of nominal masses 100mg, 2g, 20g and 500g.
- On receipt, unpack the masses using the gloves and tweezers and inspect them for any defects such as scratches, stains or finger marks.
- Leave the masses in the closed container when not in use. When ready to start, place the masses on a suitable work surface and lightly brush each mass with a brush.
- DO NOT clean the masses with solvent or cloth. Please contact PTP coordinator immediately if there is any damage.

#### Test Method and Measurements to be carried out:

The standard calibration procedure substitution weighing method with air buoyancy correction according to OIML R111-1:2004.

Consider this as a job for a normal customer. Use techniques and equipment that will allow you to report your measurements and uncertainties to your best measurement capabilities

#### Documents to be submitted:

Within **three days** of receipt of the artifact, the participant is requested to return the artifact and the result report (using the attached data sheet) to:

PTP coordinator Dr. Yaser Saleh Rahag DAC office at Admin. Building Second floor and results sheet can be send by email to: [ysrahag@dm.gov.ae](mailto:ysrahag@dm.gov.ae)

#### Final Report:

A final report will be issued at the end of the program with each laboratory only identified by a confidential code number.

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### General Information/Inquiry:

For general information, please contact Dr. Yaser Saleh Rahag - Tel: 04-3027074 or Mr. Lal Kurian Chacko - Tel: 04-3027072; and Mob. 050-7495729

### Participation Requirements

Minimum participation requirements: Participants must have

- ✓ appropriate technical capability (equipment and personnel)
- ✓ appropriate environmental conditions
- ✓ quality management system
- ✓ technical procedures for handling and measurements
- ✓ Evidence of traceability of measurements carried out

The laboratory should provide the PTP organizer with a complete uncertainty of the measurement calculation, not Best Measurement Capability. The calculations should be appropriate for the measurement being made.

### Participation Fees

*All Participants are kindly requested to come to Dubai Accreditation Department to collect the invoice and pay the participation fees 860 Dhs in advance, and in same time receiving the artifact from DAC office. No refunds are made to participants who withdraw from a round once the test materials are distributed.*



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### PTP Data Sheet

Organization: -----

Date: -----

Measurement Procedure Used:  Mass Comparator:  Other: -----

Indicate

Standards used in the measurements

The method used to estimate uncertainty

The uncertainty of the standard used as well as its traceability

Please refer to **PTP Instructions** for specific artifact calibration/handling guidelines.

**Uncertainty of Measurement:** Use the same unit of measurement as your reported value. Reported uncertainty must represent each measurement taken, **NOT** a specification of the range or just the uncertainty of the reference standards incorporated in the process.

Measurement Description	Participant's Reported Value (conventional Mass) (g)	Uncertainty of Measurement (@ K=2) (conventional Mass) (mg)
500 g		
20 g		
2 g		
0.1 g		

Comments: -----

Please submit your data to PTC on the same day as your participation upon completion of measurements.

---- End of Report ----

رؤيتنا: بناء مدينة متميزة تتوفر فيها رفاهية العيش ومقومات النجاح.  
Our Vision : To create an excellent city that provides the essence of success and comfort of living.

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E-mail : info@dm.gov.ae / Website : www.dm.gov.ae