Inter-Laboratory Comparison Protocol for OIML F1 stainless steel standards

SADCMET ILC/Mass-001/2019

Pilot Laboratory: Scientific and Industrial Research and Development Centre- National Metrology Institute (SIRDC-NMI), Zimbabwe

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1. Introduction

During the workshop for mass inter-laboratory training held in Lusaka, Johannesburg at SADCMET meeting, it was agreed to start a comparison concerning mass measurements. The main purpose of comparing the results will allow the participating laboratories to test the agreement of their results and uncertainties despite the different equipment and calibration method used.

The main objectives of this inter-comparison are to:-

- Facilitate the demonstration of metrological equivalence between the participating NMIs in the SADC region and to verify and/or establish calibration measurement capabilities (CMC).
- Enable accreditation approval for participating NMIs who wish to get accreditation for their mass laboratory.

2. Participants

The following table contains participants of this comparison.

Table 1: List of participants

NMI	Country	Contact person	Contact email
NMISA	South Africa **(Ref)**	Thomas Mautjana Daniel Mabena	tmautjana@nmisa.org dmabena@nmisa.org
SIRDC	Zimbabwe **(Pilot)**	Fedeth Mutsimba Enos Chaazi	fmutsimba@sirdc.ac.zw chaazie@sirdc.ac.zw
NSI	Namibia	Leevi Sakeus	Sakeusl@nsi.com.na
TBS	Tanzania	Vida Rusimbi	vhaika@yahoo.com vida.rusimbi@tbs.go.tz
SBS	Seychelles	Rose Kurtis	curtissamuelr@gmail.com
OCC	DRC	Rodrique Ndek	ndekkamanh@gmail.com
MBS	Malawi	Ronald Makhole	ronaldmakhole@mbsmw.org
BOBS	Botswana	Aloneh Ame Phirinyane	phirinyanea@bobstandards.bw
MSB	Mauritius	Tomeswar Pryam	tpryam@msb.intnet.mu

3. General Instructions

Each laboratory will be responsible for receiving the standards, take measurements and send the standards to the next participant according to the time schedule. Please take note that the travelling standards are to be hand carried between the institutes. Only under exceptional circumstances the transfer standards could be couriered with a company, which can deal with customs formalities.

The participating laboratories together with the coordinating laboratory shall make detailed arrangements for each time the standard is transported. An email containing the following: the method of transportation, the date the standards left the country and the expected date of entry of the next participant shall be sent to the coordinating laboratory within 1 day (24hours) of departure.

The receiving institute should inspect the standard visually. Any scratches, surface contamination or damage should be noted. The visual inspection form attached should be completed during inspection and send to the coordinating laboratory before measurements commence. Any visible dust on the surface of the standard should be removed with a soft brush provided. **DO NOT CLEAN THE STANDARDS.**

The participating laboratories shall determine the **conventional mass** values of the artifacts. It is recommended that the artifacts be placed into a balance room where they are to be measured to stabilize for at least forty eight (48) hours before measurements could be taken.

Do not check the magnetic properties of the standards and they should not be exposed to any magnetic field or close to magnets.

4. The Weights (artifact)

The chosen mass standards are a set of OIML shape stainless steel (non-magnetic) mass pieces, without cavities with nominal values 2 kg, 1 kg, 500 g 200 g and 500 mg.

The serial numbers for the artifacts are in listed in table 2 below:

Table 2: Serial numbers for te artifacts

Nominal	Serial number
2 kg	36429132/ CTA2
1 kg	36429223/ DPS200
500 g	36429388/ BQT500
200 g	36629096/ C771
500 mg	NP50

The densities for all weights should be assumed to be 7950 kg/m^3

5. Transfer package

The transfer package will contain all standards with a total weight of approximately 8 kg including the transfer standards tweezer, 1 pair of gloves and a brush.

6. The measurement procedure

Each participating laboratory shall use its own calibration procedure, ABA or ABBA substitution method and its own instruments/equipment to determine the conventional mass of the artifacts. It is recommended that artifacts and reference standards be at least 48 hours into the laboratory before any measurements is performed.

7. Time schedule

Each participating laboratory will have 4 weeks to accept, take measurements and send to the next laboratory. The artifacts should be at the next laboratory by no later than the 1st working day of the month. The time schedule is as follows in Table 3:

Table 3: ILC schedule

Number	NMI	Country	Participation Date
1	NMISA	South Africa	March 2019
2	SIRDC	Zimbabwe	April 2019
3	BOBS	Botswana	May 2019
4	NSI	Namibia	June 2019
5	MBS	Malawi	July 2019
6	SBS	Seychelles	August 2019
7	MSB	Mauritius	September 2019
8	TBS	Tanzania	October 2019
9	OCC	DRC	November 2019
10	NMISA	South Africa	December 2019

The comparison will be completed in December 2019. The Draft A report will be circulated by February 2020 and Draft B in March 2020 and final report will be sent to the Chair of SADCMET TC-1 in May 2020.

8. Transfer Standards

The transfer standards will be monitored for stability prior to circulation and during this comparison.

9. Transport and Costs

Participating laboratory will be responsible for all costs associated with measurements, transportation to the next laboratory, any costs which customs may charge and damage caused at the laboratory facilities. In the case where total loss of the artifacts, the comparison will be terminated and the report will be developed based on the results collected. The artifacts will be packed in a transportation package which will be provided.

10. Receipt of the Artifacts

As soon as the artifacts arrive, the participating laboratory shall inform the pilot laboratory by email. After receipt a visual inspection (checking for any damages) should be made and results be noted on the corresponding form (appendix 1). The coordinating lab shall be informed of the results of the inspection by email, before commencement of the measurement.

11. Reporting of results

Each participant will determine the conventional mass of the standards with respect to its own working/reference standards in stainless steel.

- Each participant will report its results to the pilot laboratory within four (4) weeks (1 month) of completing its measurements. An example of reporting results is shown in Table 4 below.
- The reported results in air should be traceable to the International Prototype of the kilogram and the calculated uncertainties should be as per Guide to the Expression of Uncertainty in Measurement (GUM) document.

Table 4: Example for reporting results

Nominal Value (g)	Conventional Mass (g)	Uncertainty ±(g)
2000		
1000		
500		
500		
0.5		

The following uncertainty contributors shall be taken into account:

- Air bouyacy correction
- Repeatability
- Standard
- Drift of standard
- Resolution of weighing instrument

12. Confidentiality

The identity of participantsô results will be kept confidential by means of a unique code known only to the participant.

13. Reference values and degree of equivalence

NMISA will provide the reference values for the ILC since all the participating laboratories obtain their traceability from NMISA.

14. Analysis of Results

The measurement results together with their associated uncertainties of measurement, as reported by the participant laboratory, will be used to calculate

ñNormalised Errorò (E_n) values as follows:-

$$En\ Value = \left| \frac{Lab\ value - Reference\ Value}{\sqrt{(Uncertainty\ for\ lab)^2 + (Uncertainty\ for\ reference)^2}} \right|$$

OR

$$\mathbf{E_n = |(x - X)|/\sqrt{(U_{lab}^2 + U_{ref}^2)}}$$

Where:

x = measurement result of participant/lab value.

X = Reference value

U_{lab}= the Expanded uncertainty of the participating lab at 95, 45% confidence level.

U_{ref} = the Expanded uncertainty of the artifact or reference lab at 95, 45% confidence level.

15. Schedule and plan for the inter-comparison

Table 5: ILC schedule and plan

Activity	**Deadline**
Protocol	February 2019
Measurements at the reference laboratory	March 2019
Circulation and measurements by participants	April 2019 to November 2019
Measurements at the reference laboratory	December 2019
Receipt of the last measurement results by participants	December 2019
Analysis of results	January 2020
Circulation of Draft A and Comments/Corrections	February 2020
Circulation of Draft B and Comments/Corrections	March 2020
Final Report	May 2020

The deadline will be the last day of the month.

APPENDIX 1

Visual inspection form for the travelling standards

Name of Institute	
Completed by	
Date	

Record any mark(s) seen on the travelling standards (scratches, contamination etc.) and send it to the coordinating laboratory before starting measurements

1. Nominal and serial number/ identification of the traveling standard	**Nominal: 2Kg** Serial Number:36429132
Top surface	
Middle surface	
Bottom surface	
2. Nominal and serial number/ identification of the traveling standard	**Nominal: 1Kg** Serial Number:36429223
Top surface	
Middle surface	
Bottom surface	
3. Nominal and serial number/ identification of the traveling standard	**Nominal: 500g** Serial Number:36429358
Top surface	
Middle surface	
Bottom surface	
4. Nominal and serial number/ identification of the traveling standard	**Nominal: 200g** Serial Number:36629096/
Top surface	
Middle surface	
Bottom surface	
5. Nominal and serial number/ identification of the traveling standard	**Nominal: 500mg** Serial Number:NP50

APPENDIX 2

Example of a letter for security control

This must be adapted in accordance with the NMIôs and people involved in the transfer of the artifacts

April 2019

I the undersigned, Mathew Ranganai, Director of National metrology Institute (SIRDC-NMI), certify that Ms F Mutsimba, from the Mass laboratory is carrying five stainless steel mass pieces (5kg, 1kg, 500g, 200g, 500mg) from SIRDC-NMI, Zimbabwe to Botswana Bureau of Standards (BOBS), Plot Number 55745 Block 8, Main Airport Road, Private Bag BO 48,Garborone, Botswana. Tel: +267 3903200, Fax: +267390120, Toll free: 0800600900, Email: info@hq.bobsatandards.co.bw/ phirinyanea@bobstandards.bw

These mass pieces are made of stainless steel and are of huge metrology (scientific) value. They are sent between participating National Metrology Institutes and/or Bureau of Standards for inter-laboratory comparison. The standards are very fragile and must not be manipulated by unauthorized persons. Improper handling during transportation would make them useless. They are specially packed in containers that will ensures they remain clean and protected during transportation.

It is important that they travel in the cabin as hand luggage and not in the baggage hold. They are safe and do not pose any risk to the health and safety of fellow passengers.

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