Comparison on

Hand Instruments

(Dial Indicator)

Pilot Laboratory: Botswana Bureau of Standards

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1. Introduction

1.1. The aim of this comparison is to assess the equivalence of the hand instruments (Dial Indicator) calibration among the participants and to underpin the relevant claim of the Calibration and Measurement Capability in BIPM KCDB.

2. Organization

2.1. Participants

2.1.1. Botswana Bureau of Standards is acting as a pilot laboratory among the participants in the comparison for Dial indicator.

2.1.2. All the participants must be able to demonstrate traceability to an independent realization of the meter, or make clear the route of traceability to the meter via another named laboratory.

2.1.3. By their declared intention to participate in this comparison, the laboratories accept the general instructions and the technical protocols written down in this document and commit themselves to follow the procedures strictly.

2.1.4. Once the protocol has been agreed, no change to the protocol may be made without prior agreement of all the participants.

2.2. Participant Details

	Participant	**Correspondence**	**E-mail Address Phone number**	**Address**
1	BOBS (pilot)	Mr Pamidzani Ntima	ntima@bobstandards.bw	Plot No. 55745, Block 8, Main Airport Road, Gaborone, Botswana
2	South Africa	Zanele Nzimande	znzimande@nmisa.org Tel: 012 841 3057	NMISA, Bldg 5, CSIR, Meiring Naude Road - South Africa
3	Malawi	Truwe Munkhondya		
4	Mauritius	Vaneeda Ramasawmy		
5	Mozambique	Emidio Mulchande		
6	Namibia	George Mabakeng		
7	Tanzania	Angela K Charles		
8	Zambia	Natasha Chichone		
9	Zimbabwe	Burnhard P. Gandah	Email: bgandah@sirdc.ac.zw Tel: +263242860346	SIRDC National Metrology Institute, 1574 Alpes Road, Hatcliffe, Harare

2.3. Form of Comparison

2.3.1. The comparison will principally be carried out through calibration of the artifact which is a dial indicator (range: 0-25 mm).

2.3.2. Sequence of measurements will be: Pilot – Participant 1 –Pilot.

2.3.3. The comparison will consist of one round. Each participant will have two weeks period for measurements and then must send the artifacts to the next participant right away so that the artifacts can be delivered to the next participant within one month after finish of measurements. The participant should immediately report to the pilot lab when the problem happens to delay the predetermined schedule.

2.4. Timetable

3. Laboratory	Starting date of measurement
South Africa	
Mauritius	
Tanzania	
Malawi	
DRC	
Zambia	
Mozambique	
Zimbabwe	
Botswana (Pilot)	
Namibia	
Zimbabwe	

Each participant should submit measurements results (report) to the pilot within two weeks after completion of its measurements.

When all measurements are completed, the participants will be given a deadline date for submitting the results, and if they do not meet the deadline, they might be disqualified.

2.5. Handling of Artifacts

2.5.1 The artifact should be examined immediately upon receipt. The condition of the artifacts and the associated package should be noted and communicated to the pilot lab if there is anything abnormal found.

2.5.2 If there is any damage or problem found to potentially affect the comparison measurements, the participant should immediately report it to the pilot lab by e-mail. If the pilot lab finally decides to repair it after sufficient communication, the participant should deliver the artifact to NMISA for repair.

2.5.3 When the comparison measurements are completed, the artifacts should be repackaged in their original container. Please ensure that the content of the package is complete by checking the packing list that was delivered together with the artifacts. The original packaging container should be used unless it is significantly damaged. Please inform the coordinator if the participant decides to make a new container.

2.5.4 The participant should inform the contact person of the next participant and the coordinator of the pilot lab of the delivery schedule when the artifact package is ready to be sent.

2.5.5. The participant should adjust the zero position of the dial indicator before starting the measurements.

2.6. Transportation of Artifacts

2.6.1. It is important that the artifact should be transported in a manner such that they will not be lost, damaged or handled by un-authorized persons. The artifacts should be packaged in a container that is suitably robust to protect the artifacts from being deformed or damaged during transportation.

2.6.2. Transportation is at each participating lab's responsibility and cost. Each participating lab should cover the cost for its own measurements, one-way transportation including insurance, customs clearance, and any expense to be occurred in its own country.

2.6.3. Choice of transportation method is up to each participating lab.

3. Description of artifact

NMISA artifact is a dial indicator as shown in figure 1.1 that ranges from 0-25 mm, with serial number 18X23873 and 1µm.

Figure 1.1: photograph of the dial gauge

4. Measurement Instructions

4.1. Traceability

4.1.1 Temperature measurement should be made using the International Temperature Scale of 1990(ITS-90).

4.1.2 Length measurement should be traceable to the latest realization of the meter.

4.2. Measurand

4.2.1 The Calibration is performed on the length scale of the dial indicator.

4.2.2 The calibration process should be performed in suitable laboratory accommodation maintained at a temperature of 20^{o}C.

4.2.3 The exact temperature of the laboratory during the comparison measurements should be reported.

4.2.4 Correction of temperature mismatch should be made and the corresponding uncertainty should be included in the uncertainty budget in case of need.

4.3. Calibration Instruction

4.3.1. **Dial Indicator:** a number of 5 Gauge blocks are recommended to be used for calibration, which has the lengths in mm of (0.5, 1, 10, 20, and 25 mm). 3 points should be measured at each point for the ingoing measurements.

4.3.2. For repeatability, measure 1mm point 10 times in one direction

4.3.3. For repeatability, 3 times at 10 mm for outgoing measurements

4.3.4. Any other set of gauge blocks that covers the indicator range can be used.

4.3.5. The participant shall determine the value of maximum error of indicator and at which position it exists?

5. Reporting Results and Uncertainty

5.1. The report on the measurement results of each participant should include a description of the participant's measurement facility or a reference to a published work of the facility. It would be desirable to present photograph of the facility.

5.2. The report should include the information about the traceability which the participant has established and maintained.

5.3. The report should contain a comprehensive uncertainty budget, comprising all the contributions to the total uncertainty. The uncertainty of measurements shall be estimated according to the ISO Guide to the Expression of Uncertainty in Measurements.

5.4. In the uncertainty budget, the following uncertainty contributions should be included (but is not limited to):

- Uncertainty contributor due to the repeatability and reproducibility during measurements.
- Uncertainty contributor due to the reference standards used in measurements.
- Uncertainty contributor due to the Environmental effect.
- Uncertainty contributor due to Abbe effect.

5.5. Each uncertainty component should come with a probability distribution function and a degree of freedom. Finally, the combined standard uncertainty, the resultant probability distribution function, and the effective degree of freedom should be reported (Level of Confidence 95%).

5.6. The participant should submit the report by e-mail in word and pdf format to the pilot within **two weeks** after completion of measurements. In addition, the printed report should be sent to the pilot lab by e-mail. In case of any discrepancy found between the two reports, the printed one will be regarded as a definitive version and used for drafting the comparison report.

5.7. Within two weeks following the receipt of all measurement reports from the participating laboratories, the pilot laboratory will analyze the results and prepare first draft reports on each comparison. These will be circulated to the

participants for comments and corrections. The procedure outlined in the BIPM Guidelines will be followed.

5.8. The mean value of the differential group delay and the combined standard uncertainty for each artifact will be used to calculate the comparison reference value.