

**SADCMET LS1 comparison**

**Calibration of End Standards up to 100 mm  
Technical Protocol (Draft A)**

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## 1. Introduction

- 1.1 Equivalence of National Metrology Institutes is becoming more and more important. This is established by key comparisons set out by the CIPM. Specific key comparisons are decided upon and organised by the Consultive Committee for a specific field, which, in this case is the Consultive Committee for Length (CCL).
- 1.2 This technical protocol has been drawn up by the NML (South Africa). The procedure, which follows the guidelines established by the BIPM<sup>1</sup>, is based on the existing technical protocol document for the key comparison on gauge blocks<sup>2</sup>.
- 1.3 The goal of the comparisons for topics in dimensional metrology is to demonstrate the equivalence of routine calibration services offered by NMIs to clients, as listed in Appendix C of the BIPM Mutual Recognition Agreement (MRA). To this end, participants in this comparison agree to use the same apparatus and methods as is routinely applied when calibrating client artefacts.

## 2. Organisation

### 2.1 Participant Requirements

- 2.1.1 The laboratory must offer this capability as a calibration service.
- 2.1.2 Finally, uncertainty budgets: for example, gauge blocks' uncertainty budgets are cognate to all National Metrology Institutes. The participants must be able to present a detailed uncertainty budget.
- 2.1.3 By their declared intention to participate in this key comparison, the laboratory accepts the general instructions and technical protocols as stated in this document and commits themselves to follow the procedures rigorously.

<sup>1</sup> TJ Quinn, *Guidelines for CIPM key comparisons*, 1 March 1999, Paris

<sup>2</sup> R Thalmann, J Dekker, N Brown, *CCL Key comparison: Calibration of gauge blocks by interferometer*, April 1998

## 2.2 Participants

2.2.1 A list, tabled below, of participating laboratories was drafted.

<b>Pilot Laboratory</b>		
Mr O A Kruger	National Metrology Institute Of South Africa Meiring Naude road Pretoria 0001 SOUTH AFRICA	Tel: + 27 12 841 3005 Fax + 27 12 841 4458 e-mail: <a href="mailto:oakruger@nmisa.org">oakruger@nmisa.org</a>
<b>SADCMET</b>		
	Zimbabwe	
	Zambia	
	Kenya	
	DRC	
	Uganda	
	Tanzania	
	Mauritius	
	Mozambique	
	??	

## 2.3 Time Schedule

- 2.3.1 The comparison will commence with the NMISA as the pilot laboratory. On completion of the comparison the artefacts will be returned to the pilot laboratory for verification of either drift or damage to the artefacts.
- 2.3.2 Each laboratory will have one month (4 weeks) in which to perform the calibration and a further 2 weeks to pass it on to the next laboratory. The schedule must be kept and no deviation from it will be allowed. Should a laboratory experience problems, be it in the measurements of the artefacts or with the customs of a country, the allotted time must be adhered to, even if it means not completing the measurements. Otherwise, the time schedule starts to run behind and it is very difficult to get back on track, which is unfair to the remaining laboratories.

2.3.3

<b>Region</b>	<b>Laboratory</b>	<b>Start Date</b>
Pilot laboratory	NMISA	2009
Pilot laboratory		

**2.4 Handling of artefacts**

- 2.4.1 The gauges should be examined immediately upon receipt. The condition of the gauges should be noted and communicated to the pilot laboratory. Please use the return form; appendix A4.
- 2.4.2 No re-lapping or re-furbishing of the artefacts should be attempted. Laboratories should attempt to measure all gauges/artefacts, unless in doing so would result in damage to their equipment or the gauges.
- 2.4.3 The gauges should be inspected before being dispatched and any change in their condition during the measurements at the laboratory should be communicated to the pilot laboratory.
- 2.4.4 The laboratory must also inform the next laboratory via fax or e-mail when the artefacts are to be sent to them.
- 2.4.5 After the measurements, the artefacts must be packed in the original packaging before shipment to the next laboratory.

## 2.5 Transportation of artefacts

- 2.5.1 It is very important that the artefacts be packed and transported in the best possible manner, thus eliminating either damage, being lost or handled by unauthorised persons.
- 2.5.2 The artefacts should be accompanied by a suitable customs carnet (where appropriate) or documentation uniquely identifying the items. The packaging should be easily opened to enable inspection by custom officials.
- 2.5.3 Each laboratory must cover the cost of it's own measurements; transportation to the next laboratory and any custom's charges incurred. The laboratory is also responsible for any damages which may occur within the country during the measurements and transportation. The pilot laboratory has no insurance for any loss or damage to the artefacts during transportation.

## 3. Description of artefacts

- 3.1 The artefacts to be measured consist of a nine gauge blocks. There are three steel, three ceramic and three Tungsten Carbide gauge blocks, according to the international standard ISO 3650.
- 3.2 The sizes are:
  - Ceramic; 1, 5, 50 mm
  - Steel; 2, 25, 100 mm
  - Tungsten Carbide; 1, 10, 75 mm

## 4. Measurement Instructions

### 4.1 Definitions

- 4.1.1 The gauge blocks have reflecting side faces which serve as measuring faces. In ideal conditions the individual measuring faces are parallel to each other. In practice, the measuring faces are not.

### 4.2 Measurement methods

- 4.2.1 The gauge blocks are to be measured with interferometry or by comparison according to the laboratories **internal procedures**, with parameters defined as in ISO 3650. This describe the terminology for the; i) central length, ii) deviation from flatness, iii) variation in length. All of which must be measured for this comparison.

## **5. MEASUREMENT UNCERTAINTIES**

- 5.1 The uncertainty for the measurements of both the gauge blocks must be according to *ISO Guide for the Expression of Uncertainty in Measurement*.
- 5.2 All the measuring uncertainties must be included in the uncertainty budgets for. A template of the uncertainty budget, for gauge block by comparison is attached in Appendix A3.
- 5.3 The uncertainty must be stated as the combined standard uncertainty ( $k=1$ ) and also be stated as the expanded uncertainty for  $k=2$ . The effective degrees of freedom must also be reported.

## **6. REPORTING OF RESULTS**

- 6.1 According to the definitions, the central length deviations, deviation from flatness and the parallelism (variation in length) of the gauge block must be reported.
- 6.2 The results must be sent to the pilot laboratory within 2 months of the completion of the measurements.
- 6.3 The reference value to be used in this comparison has still to be decided upon. It is however proposed by the WGDM (Working Group Dimensional Metrology) that a weighted average of the results, with weighting factors as normally derived from the stated uncertainties of the results be used as the reference value.

**A.1 Measurement results**

**Laboratory:**.....

**Method of measurement (as per 4.2.1):**.....

**Calibration table:**

<b>Nominal value (mm)</b>	<b>Central length deviation (µm)</b>	<b>Deviation from flatness of face 1</b>	<b>Deviation from flatness of face 2</b>	<b>Variation in length between the faces</b>	<b>Effective degrees of Freedom <math>\nu_i</math></b>
<b>Ceramic 1</b>					
<b>Ceramic 5</b>					
<b>Ceramic 50</b>					
<b>Steel 2</b>					
<b>Steel 25</b>					
<b>Steel 100</b>					
<b>TC 1</b>					
<b>TC 10</b>					
<b>TC 75</b>					

**Date:**.....

**Signature:**.....

**A.2 Description of the measuring system/set-up**

**Make and type of comparator/interferometer (include the uncertainty of the instrument calibration if app.)**

.....  
.....  
.....  
.....

**Make and type of standard gauge block used (include the uncertainty of the standard)**

.....  
.....  
.....  
.....

**Procedure of the measuring set-up used**

.....  
.....  
.....  
.....  
.....  
.....







**A.4Return form**

**Attention: Mr O Kruger  
National Metrology Institute of South Africa  
P O Box 395  
Building No 5  
CSIR  
Pretoria  
South Africa  
Fax: +27 12 841 4458  
e-mail: oakruger@nmisa.org**

**We confirm having received the artefacts for the SADC MET –LS1 key comparison on gauge block standards on ..... (date)**

**After visual inspection:**

**No damage has been observed**

**Damage has been observed (detailed comments)**

.....  
.....  
.....

**Laboratory:.....**