

Bilateral Interlaboratory Comparison (Length) 2012

Calibration of gauge blocks by comparison

Technical protocol

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1. Introduction

The following protocol was sent to the participants in advance, allowing for questions and remarks. It has been accepted by all participants in this form.

1.1 General Information

This protocol contains information about the Bilateral InterLaboratory Comparison between CME and PTB. The pilot laboratory is the PTB Physikalisch – Technische Bundesanstalt.

PTB will provide the participating laboratory with individual feed back upon request and will evaluate the results of the comparison measurements.

2. Organisation

The technical protocol has been drafted by the pilot laboratory with assistance from CME.

2.1. Participants

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2.2. Time schedule

The laboratory has approximately 4 weeks for calibration of the gauge block including customs clearance and transportation.

If for some reasons, the measurement facility is not ready or customs clearance takes too much time in a particular country, the laboratory has to contact the coordinator immediately.

CIRCULATION SCHEME

Laboratory	Country	Date
PTB	Germany	28.08.2012 – 19.09.2012
CME	Tunisia	20.09.2012 – 18.10.2012
PTB	Germany	19.10.2012 – 18.11.2012

2.3. Transportation

Transportation is each laboratory's own responsibility and cost.

2.4. Unpacking, Handling, Packing, Insurance

The package (cardboard box) contains one wooden box containing 10 gauge blocks.

After receiving the package, the standards have to be inspected carefully for any damage, scratches or rust. The gauges should be de-greased. **The gauge blocks must be handled with care!** Any damage has to be communicated to the pilot laboratory.

After the measurements the gauge blocks have to be cleaned and should be **greased**. All gauges should be wrapped in paper. Ensure that the content of the package is complete before shipment.

Each participating laboratory covers the costs for the measurements, transportation and eventual customs formalities as well as for any damages that may have occurred within its country. The pilot laboratory has no insurance for any loss or damage of the standards during transportation.

3. Description of the gauge blocks under test

The package contains 10 gauge blocks made of steel with rectangular cross section, according to the international standard ISO 3650.

Steel gauge blocks:

Identification No.	Nominal length mm	CTE (10^{-6} K^{-1})	Manufacturer
070179	0,5	unknown	Mitutoyo
070100	1,001	unknown	Mitutoyo
060402	1,6	unknown	Mitutoyo
060409	3	unknown	Mitutoyo
072093	7	unknown	Mitutoyo
080027	24	unknown	Mitutoyo
070761	40	unknown	Mitutoyo
063190	75	unknown	Mitutoyo
061393	90	unknown	Mitutoyo
072732	100	unknown	Mitutoyo

Table 1

4. Measurement instructions

Before and **after** the calibration, the gauge blocks have to be inspected on damages on the measurement surfaces. Any scratches, rusty spots indentations or other damages have to be documented by a drawing or sketch in the appropriate form in the **annex 2**.

The **wringing** properties have to be checked and the results recorded.

If a re-lapping or re-polishing of the measurement surfaces is necessary the laboratory has to inform the Pilot laboratory before the reconditioning will be carried out.

The gauges should be left in the laboratory environment for an adequate period to allow temperature stabilisation. The gauge block temperature should be recorded at the beginning and end of the calibration.

The gauge blocks should be measured by mechanical comparison with the laboratory's reference gauge blocks, using the normal calibration procedure.

The pilot laboratory will measure the length of the gauge blocks by the interferometry and the variation in length by mechanical method.

The deviation of the central length from the nominal length ($l_c - l_n$) according to ISO 3650 is the measurand for the gauge blocks.

Additional measurements:

To get more information about the quality of the gauge blocks the deviations from central length should be measured at the 4 corners of the measuring face. These values will be used by the laboratory to calculate the maximum deviations f_o and f_u from the nominal length for each gauge, according to ISO 3650. These measurements serve as a check of the parallelism of the gauge blocks to calculate measurement uncertainty budget.

The results should be recorded in **Annex 1**.

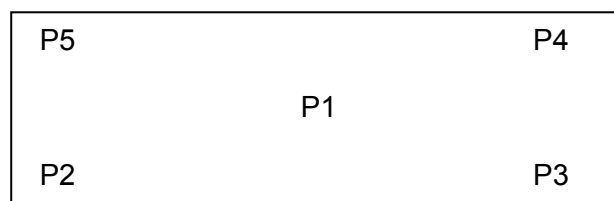


Figure 1. Measurement points on the surface of the gauge block

The gauges should be positioned as follows:

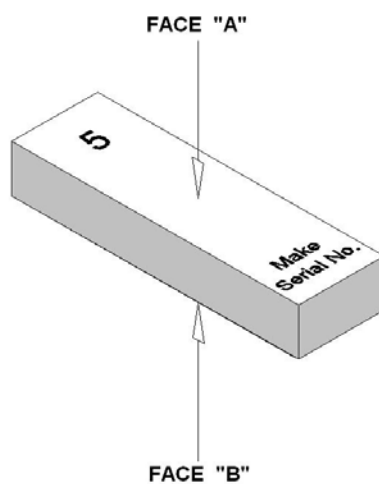


Figure 2. Gauge Block with nominal length < 6 mm.

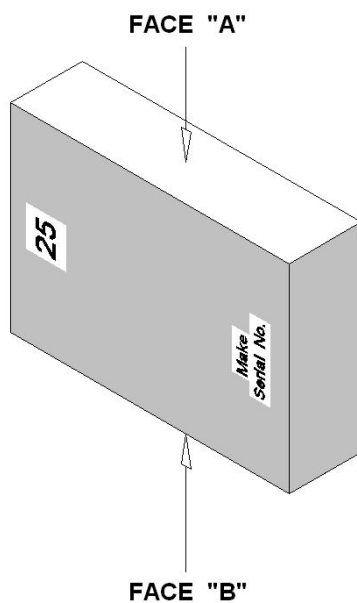


Figure 3. Gauge block with nominal length ≥ 6 mm.

5. Measurement uncertainty

The uncertainty of measurement shall be estimated and reported as would be normal for mechanical comparison according to the *ISO Guide for the Expression of Uncertainty in Measurement*.

5.1 Mathematical model and measurement uncertainty

All participating laboratories shall state the mathematical model they apply and their uncertainty budget established according to their current calibration procedure and shall state the uncertainty sources they consider in their procedure. They shall submit the mathematical model as an equation and shall define each of the variables. According to the submitted model they should fill an uncertainty budget chart for a 0.5 mm and 100 mm gauge block. Both, mathematical model as well as the uncertainty budget chart shall be reported in **Annex 3**.

6. Reporting

The quality of the measurement surfaces of the gauge blocks, the measurement results, instrument descriptions and a detailed evaluation of the uncertainty of measurement have to be reported using the forms enclosed in the annex. Handwritten notes are sufficient but electronic submission is preferred.

The measurement report forms in the annex of this document are sent by e-mail (Word document) to all participating laboratories. It would be appreciated if the report forms (in particular the results sheet) could be completed by computer and sent back electronically to the coordinator. **In any case, the signed report must also be sent in paper form by mail.** In case of any differences, the paper forms are considered to be the valid version.

The reports shall be sent to the pilot laboratory **within six weeks** after completing the measurements. No information about differences of the reported results with respect to other laboratories will be discussed before the completion of the comparison, unless large deviations of particular laboratories with respect to the preliminary reference results obtained by the pilot laboratory have been observed. In the latter case the laboratory in question will be contacted.

Within 3 months after completion of the circulation, the pilot laboratory will prepare a first draft report and send it to the participants for comment. Subsequently, the procedure outlined in the BIPM Guidelines will be followed.

Annex 1: Measurement results for steel gauge blocks

Steel gauge blocks:

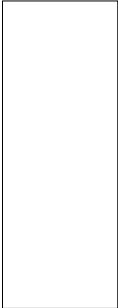
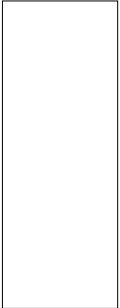
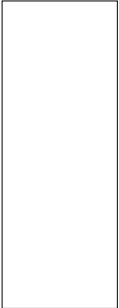
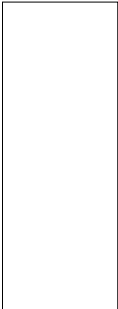
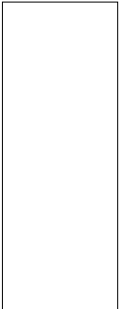
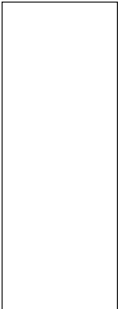
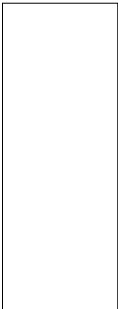
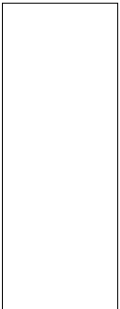
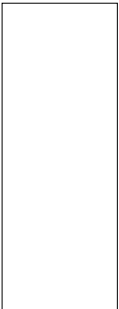
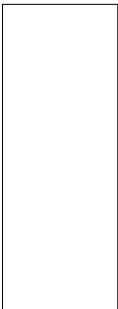
Nominal length	Deviation of the central length from the nominal length	Uncertainty ($k=1$)	Deviation from the central length	Deviation from nominal length	Uncertainty ($k=1$)	Ident.-No.
in mm	$l_c - l_n$ in μm	u in μm	f_o in μm	f_u in μm	u in μm	
0.5						070179
1.001						070100
1.6						060402
3						060409
7						072093
24						080027
40						070761
75						063190
90						061393
100						072732

Laboratory:.....

Date:.....Name.....Signature.....

Annex 2: Physical conditions of the gauge blocks upon reception

After a detailed inspection of the measurement surfaces of the gauge blocks these are the results

0.5 mm A  B 	1.001 mm A  B 	1.6 mm A  B 
3 mm A  B 	7 mm A  B 	24 mm A  B 
40 mm A  B 	75 mm A  B 	90 mm A  B 
100 mm A  B 		

Laboratory:.....

Date:.....Name.....Signature.....

Observations:

Laboratory:.....

Date:.....Name.....Signature.....

Annex 3:

Mathematical model and measurement uncertainty form.

Please prepare a detailed uncertainty budget for the calibration of the 0.5 mm and the 100 mm gauge block.

The statement of uncertainty in the result form in Annexes 1 should be consistent with the ISO-Guide for the expression of uncertainty in measurement.

Please indicate below if possible, the different input quantities which have been used to estimate the reported uncertainty. Please extend and edit the tables as necessary.

Mathematical Model¹ (equation):

Definition of variables in the model:

Uncertainty evaluation for the 0.5 mm steel gauge block

Uncertainty evaluation for the 100 mm steel gauge block

Laboratory:.....

Date:.....Name.....Signature.....

Annex 4: Description of the measurement instrument

Make and type of comparator

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Equipment and auxiliary devices

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.....

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Resolution of Comparator & electronics

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.....

Type and uncertainty of reference gauge block used

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Range of gauge block temperature during measurement.....

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.....

.....

Laboratory:.....

Date:.....Name.....Signature.....

Telefax or e-mail

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e-mail: metrologie_mekki@yahoo.fr

We confirm having received the gauge blocks of the *Bilateral Comparison: Calibration of Gauge Blocks by mechanical comparison* on..... (date)

After visual inspection

- ☐ no damage has been noticed.
☐ the following damage(s) must be reported:

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

Date:

Name

Signature:

.....

.....
