National Institute of Metrology (Thailand)

NIMT

APMP Supplementary Comparison
APMP.L-S3.4.01

Calibration of Angle Gauge Blocks
Technical protocol

National Institute of Metrology (Thailand), (NIMT)

1. Document control

Version Draft 1 Issued on 16 September 2019
Version Draft 2 Issued on 23 April 2021

2. Introduction

The broad objective of the Asia Pacific Metrology Program (APMP) is to improve the measurement capabilities in the Asia Pacific region by sharing facilities and experience in metrology. Comparison of calibrations by different laboratories on given artifacts adds confidence in the measurement of standards and leads to international acceptance of the measurements carried out by these laboratories. This intercomparison concerns the calibration of angle gauge blocks.

Standards circulated to all laboratories consist of four (4) angle gauge blocks.

3. Organization

3.1. Participants

Cooperation of all participants is essential for a successful intercomparison.
Participants are listed in Table 1. They are expected to:
- Provide correct and up to date contact and address details to the pilot laboratory.
- Have all resources and instrumentation ready by the scheduled month of measurement and commit to carry out measurements according to the schedule (Table 2).
- Ensure funds are available for onward transport of the artifacts.
- Select a suitable agent for forwarding the artifacts to the next participant and organize smooth movement through customs using appropriate documents.
- On receipt of the artifacts, inform the program pilot (by email) of receipt, any damages to the standards or the box or of any other problems or delays (Appendix B).
- Calculate a mean result and associated uncertainty.
- On completion of measurements, re-examine the condition of each standard and notify the coordination of any change (Appendix B).
- Repack the artifacts and make transport arrangements. Ensure that the set of documents are enclosed. Inform the next participant in advance. ATA Carnet will be supplied for those countries that participate in this scheme. The schedule has been set to make efficient use of the Carnet scheme.
- Supply all results, calibration reports, uncertainty calculations and Appendix D summary to the pilot laboratory within 6 weeks of receipt of the artifacts.
- Agree not to discuss any measurement results prior to distribution of the draft report (after completion of all measurements).

Table 1. List of participant laboratories and their contacts

Country	Laboratory code	Contact person	Address	Contact details
Thailand	NIMT	Ms. Ketsaya Vacharanukul, Mr.Watcharin Samit	3/4-5 Moo 3, Klong 5, Klong Luang, Pathumthani 12120, Thailand	Tel: +66 25775100 ext 1216 e-mail: ketsaya@nimt.or.th watcharin@nimt.or.th
Australia	NMIA	Mr. Peter Cox	National Measurement Institute Unit 1/153 Bertie Street, Port Melbourne, Victoria 3207, Australia	Tel: +61 3 9644 4906 email: peter.cox@measurement.gov.au
Indonesia	SNSU-BSN	Mr. Okasatria Novyanto, Ms. Nurul Alfiyati	Komplek Puspiptek, Ged.420, Setu, Tangerang Selatan, Banten 15314 Indonesia	Tel:+62 21 7560533 ext 3078 e-mail: okasatria@bsn.go.id nurul@bsn.go.id
Malaysia	NMIM	Mr. Razman Mohd Halim, Ms. Rafidah Rosli	National Metrology Institute of Malaysia Lot PT4803 Bandar Baru Salak Tinggi 43900 Sepang, Selangor Malaysia	Tel: +603-87781613 e-mail: razmanmh@sirim.my rafidahr@sirim.my
Saudi Arabia	SASO-NMCC	Mr. Faisal AlQahtani, Mr. Yasser Bin Talha	Saudi Standards, Metrology and Quality Org. National Measurement and Calibration Center (Building No.4) Riyadh – Al Muhammadiyah -in front of King Saud	Tel: +966112529726 e-mail: f.qahtany@saso.gov.sa Tel: +966112529714 e-mail: y.talhh@saso.gov.sa
Singapore	NMC/A*STAR	Dr Tan Siew Leng	National Metrology Centre 2 Fusionopolis Way, #08-05, Innovis, Singapore 138634 Singapore	email: tan_siew_leng@nmc.a-star.edu.sg
United Arab Emirates	UAE EMI	Mr. Majed Sultan Ali Saeed Al Senaidi	Masdar city, AbuDhabi, United Arab Emirates	Tel: +97124066666, +971506684887 e-mail: m.alsenaidi@qcc.gov.ae
Vietnam	VMI	Mr. Tong Cong Dung, Mr. Vu Khanh Phan	No 8 - Hoang Quoc Viet street, Cau Giay district, Ha Noi 100000, Viet Nam	Tel: +84 986 025 520 e-mail: dungtc@vmi.gov.vn Tel: +84 334 562 818 e-mail: phanvk18@gmail.com
Ukraine	UMTS	Ms. Anna Fursa, Mr. Yuri Glushko	State Enterprise "All-Ukrainian State Scientific and Production Center of Standardization, Metrology, Certification and Protection of Consumer" (SE "Ukrmetrteststandard"), 4, Metrologichna Str., 03143, Kyiv-143, Ukraine	Tel: +38 044 526 3619 e-mail: fursa@ukrcsm.kiev.ua Tel: +38 098 423 9322 e-mail: yygeom@gmail.com

3.2. Schedule

3.2.1. The comparison will commence with NIMT as the pilot laboratory followed by a number of participants and send back to NIMT. On completion of the comparison the artifacts will be returned to the pilot laboratory for verification of either drift or damage to the artefacts.

3.2.2. Each laboratory will have one month (4 weeks) in which to perform the calibration and to pass the artifacts on to the next listed laboratory. With its confirmation to participate, each laboratory has confirmed that it is capable to perform the measurements within the allotted time. If laboratory experience problems, be it in the measurements of the artefacts or with the customs of a country, the laboratory has to contact the pilot immediately and according to the arrangement made, to send the artifacts directly to the next laboratory even if it means not completing the measurements.

Table 2. Schedule of the comparison. (proposed)

Laboratory	Carnet	Starting date of measurement
NIMT	Yes	December 2021
NMIM	Yes	April 2022
NMIA	Yes	May 2022
NIMT	Yes	June 2022
UAE EMI	Yes	July 2022
SNSU-BSN	Yes	August 2022
SASO-NMCC	No	September 2022
VMI	Yes	October 2022
NMC/A*STAR	Yes	December 2022
UMTS	Yes	January 2023

3.3. Reception, transportation, insurance, costs

A wooden case containing 4 angle gauge blocks, is used for the transportation of the artifacts as shown in figure 1. Upon reception of the package, each laboratory has to check that the content is complete and that there is no apparent damage on the box or any of the standards. The reception has to be confirmed immediately to the pilot with a copy to the former participant (sender), preferably using the form of Appendix A.

Figure 1 – Transporting case

No re-lapping or re-furbishing of the artifacts should be attempted.

The organization costs will be covered by the pilot laboratory, which include the standards themselves, the cases and packaging, and the shipping costs to the next laboratory. Each laboratory must cover the cost of its own measurements; transportation to the next laboratory with insurance against loss or damage 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 of the standards during the circulation.

Once the measurements have been completed, the package shall be sent to the following participant and please inform the pilot laboratory and the following participant when the package leaves your installations indicating all pertinent information. If, at any point during circulation, the package is damaged, it shall be repaired by the laboratory before shipping it again. It is very important that the artifacts be packed and transported in the best possible manner, thus eliminating either damage, being lost or handled by unauthorized persons.

The gauges need to be protected against corrosion when not being measured by means of protective oil. Please protect them before packing them for transportation or when stocked for more than three days.

For shipment to country with ATA carnet needed, the package is accompanied by an ATA carnet. The carnet shall always be shipped with the package, never inside the box. **Please be certain, that when receiving the package, you also receive the carnet!**

4. Description of Artifacts

The package contains four (4) angle gauge blocks, $1'$; $25'$; $3°$ and $30°$. The angle blocks are made by Tsugami corporation with all the angle blocks having a serial number 04003. The angle blocks have a measuring face of 15 mm * 50 mm.

5. Measurement Instructions

The angle of the angle gauge blocks is defined by the angle between the measuring faces with the plane perpendicular to the line being common to both functional planes.

5.1. Measurement methods

5.1.1. The angle gauge blocks are to be measured in both the normal and inverted positions, but only one set of results; the mean, will be reported. The angle gauge blocks must be adjusted for eccentricity and laterally adjusted so that the measuring faces have a minimum run-out.
5.1.2. The autocollimator must be adjusted as precisely as possible, with its optical axis perpendicular and in true alignment to the table's axis of rotation and central to the centre of the angle gauge block faces.

5.1.3. The angle gauge blocks must be adjusted with the aid of an autocollimator in the plane perpendicular to the table's axis of rotation (measuring plane) in such a way that the pyramidal errors of all measuring faces are at a minimum, within ± 2″. The measuring axis of the autocollimator; the x-axis, must be adjusted parallel to the measuring plane of the angle gauge blocks.

5.1.4. The following methods can be used but are not prescribed;

      a) The use of an autocollimator and an index table or angle measuring table.

      b) The method of comparison with the fixed pitch angle formed by two autocollimators.

      c) Where the autocollimator in method a) is replaced with an interferometer (phase shifting). The interferometer then measures the difference in angle from the index table.

Any alternative method can be used. So long as it is a non-contact method. No probing of the surfaces is allowed.

5.2. Measurement uncertainty

The uncertainty of measurement shall be estimated according to the ISO Guide to the Expression of Uncertainty in Measurement. The participating laboratories are encouraged to use their usual model for the uncertainty calculation.

All measurement uncertainties shall be stated as standard uncertainties. If appropriate the corresponding effective degree of freedom might be stated by the participants. If none is given, ∞ is assumed.

6. Reporting of results

As soon as possible after measurements have been completed, the results should be communicated to the pilot laboratory within six weeks at the latest.

The measurement report forms in appendix B, C and D of this document will be 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 pilot. In any case, the signed report must also be sent in paper form by mail or electronically as a scanned pdf document. In case of any differences, the signed forms are considered to be the definitive version.

Following receipt of all measurement reports from the participating laboratories, the pilot laboratory will analyse the results and prepare within 3 months a first draft A.1 report on the comparison. This will be circulated to the participants for comments, additions and corrections.

7. Analysis of results

The reference value (RV) is calculated from the weighted mean of the participant results. The check for consistency of the comparison results with their associated uncertainties will be made based on the Birge ratio, the degrees of equivalence for each laboratory and each artefact with respect to the RV will be evaluated using *En* values, along the lines of the WG-MRA-KC-report-template. If necessary, artefact instability and correlations between NMIs will be taken into account.

Appendix A – Reception of Standards

To:	National Institute of Metrology (Thailand), NIMT 3/4-5 Moo 3, Klong 5, Klong Luang, Pathumthani 12120, Thailand Tel: +66 25775100 ext 1216 e-mail: ketsaya@nimt.or.th
From:	NMI: …………………………… Name:………………………………… Signature: …………………………… Date: …………………………………

We confirm having received the angle gauge blocks for the APMP.L-S3.4.01 comparison on the date given above.

After a visual inspection:

☐   There are no apparent damages.

☐   We have detected severe damages putting the measurement results at risk. Please indicate the damages, specifying every detail and, if possible, include photos. If it is necessary use additional sheets to report it.

………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………

Appendix B – Measurement results

To:	National Institute of Metrology (Thailand), NIMT
	3/4-5 Moo 3, Klong 5, Klong Luang, Pathumthani 12120, Thailand
	Tel: +66 25775100 ext 1216 e-mail: ketsaya@nimt.or.th
From:	NMI: …………………………… Name:………………………………
	Signature: ………………………… Date: ………………………………

Method of measurement: ....

Maximum pyramidal error: ....arc sec

Calibration tables:

Angle block: 1'

Angle deviation (arc sec)

Angle block: 25'

Angle deviation (arc sec)

Angle block: 3°

Angle deviation (arc sec)

Angle block: 30°

Angle deviation (arc sec)

Appendix C – Description of the measuring system/set-up

To:	National Institute of Metrology (Thailand), NIMT
	3/4-5 Moo 3, Klong 5, Klong Luang, Pathumthani 12120, Thailand
	Tel: +66 25775100 ext 1216 e-mail: ketsaya@nimt.or.th
From:	NMI: ………………………… Name:…………………………………
	Signature: ………………………… Date: …………………………………

Make and type of measuring table (include the uncertainty of the table calibration if app.)

……
……
……
……
……
……
……
……
……

Make and type of autocollimator/s used (include the uncertainty of the autocollimator/s)

……
……
……
……
……
……
……
……
……

Procedure of the measuring set-up used

……
……
……
……
……
……
……
……
……

Appendix D – Uncertainty of measurement

To:	National Institute of Metrology (Thailand), NIMT
	3/4-5 Moo 3, Klong 5, Klong Luang, Pathumthani 12120, Thailand
	Tel: +66 25775100 ext 1216 e-mail: ketsaya@nimt.or.th
From:	NMI: ………………………. Name:……………………………………
	Signature: ………………………. Date: ………………………………

Source of uncertainty	x_i	$u(x_i)$	v_i	$c_{i=}\partial\alpha_i/\partial x_i$	$u_i(\alpha_i)/sec$
		veff.			
		t distribution		$u_c^2(\alpha_i)$	

Combined standard uncertainty: $u_c(\alpha_i)$ = ……………………..