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SAMM Calibration Laboratories
SAMM Lead Assessors
SAMM Calibration Technical Assessors
SAMM Officers

SAMM CIRCULAR 3/2021

SUPPLEMENTARY REQUIREMENTS FOR ACCREDITATION OF CALIBRATION LABORATORIES

A. OBJECTIVE

This circular provides supplementary requirements for accreditation of calibration laboratories under *Skim Akreditasi Makmal Malaysia* (SAMM). This circular supersedes SAMM Circular 1/2014.

B. IMPLEMENTATION DATE

Effective date **1st January 2022.**

C. REQUIREMENTS

1. Use of manufacturer's performance verification procedure

1.1 It is noted that manufacturer's performance verification procedure has been used as laboratory calibration procedure for example, in electrical calibration laboratories. In view of the fact that, such a procedure may not adequately meet the requirements of MS ISO/IEC 17025[6], the following requirements shall apply:

a) Manufacturer's specified procedure shall not be taken as a complete calibration procedure on its own unless measurement uncertainties and other relevant aspects of metrology have been included.

b) One of the manufacturer's specified instructions in particular, is the use of a single-point calibration to represent a range. This is not recommended. However, should a single-point calibration be used to

represent a range, the linearity of the representative range for the instrument shall be characterised and established. An example of such a calibration practice can be found in *EURAMET cg-15: Guidelines on the Calibration of Digital Multimeters.*

2. Uncertainty estimation for single measurement

2.1 Where a single measurement (i.e. not repeated) is made and reported, the associated uncertainty shall be determined using pooled data.

3. Calibration and Measurement Capability (CMC)

3.1 With reference to ILAC P14:09/2020[2], a CMC is a calibration and measurement capability available to customers under normal conditions:

a) as published in the International Bureau of Weights and Measures (BIPM) key comparison database (KCDB) of the International Committee of Weights and Measures (CIPM) Mutual Recognition Arrangement (MRA); or

b) as described in the laboratory's scope of accreditation granted by a signatory to the International Laboratory Accreditation Cooperation (ILAC) Arrangement.

3.2 Under a CMC, the measurement or calibration should be:

- performed according to a documented procedure and have an established uncertainty budget under the management system of the NMI and accredited laboratory;
- performed on a regular basis (including on demand or scheduled for convenience at specific times in the year); and
- available to all customers.

4. Statement of Measurement Uncertainty on Calibration Certificates

4.1 Calibration laboratories shall evaluate uncertainties of measurement in compliance with the "Guide to the Expression of Uncertainty in Measurement" (GUM)[5].

4.2 The measurement result shall include the measured quantity value y and the associated expanded uncertainty U. In calibration certificates the measurement result should be reported as $y \pm U$ associated with the units of y and U. Tabular presentation of the measurement result may be used and the relative expanded uncertainty $U / |y|$ may also be provided if appropriate. The coverage factor and the coverage probability shall be stated on the calibration certificate. To this an explanatory note shall be added, which may have the following content:

"The reported expanded measurement uncertainty is stated as the standard measurement uncertainty multiplied by the coverage factor k such that the coverage probability corresponds to approximately 95 %."

Note: For asymmetrical uncertainties other presentations than y ± U may be needed. This concerns also cases when uncertainty is determined by Monte Carlo simulations (propagation of distributions) or with logarithmic units.

4.3 The numerical value of the expanded uncertainty shall be given to, at most, two significant digits. Where the measurement result has been rounded, that rounding shall be applied when all calculations have been completed; resultant values may then be rounded for presentation. For the process of rounding, the usual rules for rounding of numbers shall be used, subject to the guidance on rounding provided i.e. in Section 7 of the GUM[5].

Note: For further details on rounding, see the GUM[5] and ISO 80000-1:2009[4].

4.4 Contributions to the uncertainty stated on the calibration certificate shall include relevant short-term contributions during calibration and contributions that can reasonably be attributed to the customer's device. Where applicable the uncertainty shall cover the same contributions to uncertainty that were included in evaluation of the CMC uncertainty component, except that uncertainty components evaluated for the best existing device shall be replaced with those of the customer's device. Therefore, reported uncertainties tend to be larger than the uncertainty covered by the CMC. Contributions that cannot be known by the laboratory, such as transport uncertainties, should normally be excluded in the uncertainty statement. If, however, a laboratory anticipates that such contributions will have significant impact on the uncertainties attributed by the laboratory, the customer should be notified according to the general clauses regarding tenders and reviews of contracts in MS ISO/IEC 17025[6].

4.5 As the definition of CMC implies, accredited calibration laboratories shall not report a smaller measurement uncertainty than the uncertainty described by the CMC for which the laboratory is accredited.

4.6 As required in MS ISO/IEC 17025[6], accredited calibration laboratories shall present the measurement uncertainty in the same unit as that of the measurand or in a term relative to the measurand (e.g. percent, µV/V or part per 10^6).

5. Statement of Metrological Traceability on Calibration Certificates

5.1 In accordance with the requirement of Clause 7.8.4.1 c) of MS ISO/IEC 17025:2017[6], a calibration certificate shall include a statement identifying how the measurement results are metrologically traceable.

5.2 Calibration results from laboratories conforming to MS ISO/IEC 17025:2017[6] provide metrological traceability. Certified values of certified reference materials from reference material producers conforming to ISO 17034 provide metrological traceability.

5.3 Accepted paths of establishing metrological traceability to the International System of Units (SI) are as described in SAMM Policy 2 (SP2)[8].

5.4 **Appendix A** provides some examples of metrological traceability statements reflecting the different paths that may be adopted by calibration laboratories.

6. Scope of accreditation of calibration laboratories

6.1 The presentation of the scope of accreditation for calibration laboratory shall be formatted as in Table 1.

Table 1- Scope of accreditation

Instrument calibrated/ Measurement parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
Instrument/Parameter, Generate, Measure, Specific values or other values	− SI requirements, usage and formatting see **Note 2** − Starting point to end point − Starts at detection limit − Specific value	− See **Note 1** − Expressed as single value or equation − May include floor uncertainty − Preferably in SI units − Not more than 2 significant digits	− Measurement standards − Calibration method − Measurement conditions − Limitations − Reference documents
	− Range & CMC can be combined in matrix format		

Note 1: The uncertainty covered by the CMC shall be expressed as the expanded uncertainty corresponding to a coverage probability of approximately 95 % and have a coverage factor of k=2 unless stated otherwise.

Note 2: Writing unit symbols and names, and expressing the values of quantities shall be in accordance with SI Brochure published by BIPM. This document is available at https://www.bipm.org/utils/common/pdf/si-brochure/SI-Brochure-9.pdf

6.2 Examples of presentation in various fields of calibration are as shown in **Appendices B, C, D and E.**

7. Calibration on weighing instruments

7.1 Weighing instruments are sensitive to transportation, their environment and changes in gravity. Consequently, weighing instruments shall be calibrated at the location at which they are installed and used.

8. Recalibration date in calibration certificate and calibration label

8.1 The calibration laboratory shall not provide a statement on calibration interval in calibration certificate and label except under the following conditions:

a) where such interval is specified by legal requirements;

b) where such interval has been agreed between the laboratory and customer. The agreed interval shall be based on sound metrological considerations. Elements of such considerations can be found in *ILAC G24: Guidelines for the determination of calibration intervals of measuring instruments.*

8.2 Records of such legal requirements and/or agreement between the laboratory and customer as specified by Clause 7.8.4.3 of MS ISO/IEC 17025[6] shall be maintained.

8.3 Where a recalibration date is specified in the calibration certificate, the laboratory shall include the following information:

a) The statement “Recalibration date requested by customer”.

b) Cautionary statement(s) to the effect that the customer is ultimately responsible for the performance of the instrument within the calibration interval. An example of such a statement is as follows:
“The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired”.
The cautionary statement or reference to the cautionary statement shall be clearly stated next to the recalibration date on the same page.

c) Where applicable, the laboratory shall highlight other relevant documents where the recommended calibration interval for such an instrument is specified.

REFERENCE:

[1] EURAMET cg-15: Guidelines on the Calibration of Digital Multimeters.
[2] ILAC P14:09/2020 ILAC Policy for Uncertainty in Calibration.
[3] ILAC G24:2007 Guidelines for the Determination of Calibration Intervals of Measuring Instruments.
[4] ISO 80000-1: 2009 Quantities and Units- Part 1: General.
[5] JCGM 100:2008, GUM 1995 with minor corrections, Evaluation of Measurement Data – Guide to the Expression of Uncertainty in Measurement.
[6] MS ISO/IEC 17025:2017, General Requirements for the Competence of Testing and Calibration Laboratories.
[7] SI Brochure: The International System of Units (SI).
[8] SAMM Policy 2 (SP2) - Policy on The Metrological Traceability of Measurement Results.

Appendix A (Informative) *– Examples of Statements of Metrological Traceability*

General

In coming out with the appropriate statement of metrological traceability in the calibration certificates, accredited calibration laboratories shall be aware of the calibration traceability of the reference standards and certified reference materials (CRMs) / reference materials (RMs) that are used to provide the measurement results in the certificates issued.

The reference standards could be calibrated by:

(i) a calibration laboratory whose scope of service is accredited by an Accreditation Body (AB) that is covered by the ILAC Arrangement or by Regional Arrangements recognised by ILAC, or

(ii) a National Metrology Institute (NMI) whose service is covered by the International Committee for Weights and Measures Mutual Recognition Arrangement (CIPM MRA).

The CRMs used could be produced by:

(i) a NMI whose service is included in the BIPM KCDB,

(ii) an accredited Reference Material Producer (RMP) whose scope of service is accredited by an AB that is covered by the ILAC Arrangement or by Regional Arrangements recognised by ILAC,

(iii) reference to entries in the Joint Committee for Traceability in Laboratory Medicine (JCTLM) database.

Examples of statement of metrological traceability

The following statements below may accordingly be declared depending on the different paths of traceability of the reference standards and CRMs used by the calibration laboratories.

Example 1 – Reference standards of SAMM-accredited Laboratory are solely calibrated by the National Metrology Institute of Malaysia (NMIM).

This certificate is issued in accordance with the laboratory accreditation requirements of Skim Akreditasi Makmal Malaysia (SAMM) of Standards Malaysia which is a signatory to the ILAC MRA. The measurement results included in this document are traceable to Malaysian national measurement standards maintained by the National Metrology Institute of Malaysia (NMIM). NMIM is a signatory to the CIPM MRA.

Example 2 – Reference standards of SAMM-accredited Laboratory are calibrated by NMIM and other national metrology institutes.

This certificate is issued in accordance with the laboratory accreditation requirements of Skim Akreditasi Makmal Malaysia (SAMM) of Standards Malaysia which is a signatory to the ILAC MRA. It provides traceability of measurement to the SI system of units and/or to units of measurement realised

at the National Metrology Institute of Malaysia (NMIM) and other recognised national metrology institutes.

Example 3 – This statement refers to the case where the SAMM-accredited Laboratory wishes to refer to a calibration certificate(s) of the reference standard(s) that was used by the Laboratory in reporting the measurement results of the certificate issued.

The results of the calibration are traceable to …(*specify country*)… national standards through …(*specify the accreditation body's accreditation no. of laboratory*)… via calibration Certificate No. xxx dated ddmmyyyy. *(Specify* n*ame of the accreditation body)* is a signatory to the ILAC MRA (*or specify name of Regional Arrangement recognized by ILAC as appropriate*).

Example 4 – Certified Reference Materials (CRM) of SAMM-accredited Laboratory are produced by an accredited Reference Material Producer (RMP).

The measurement results in this certificate are metrologically traceable to CRM values established by an accredited RMP…(*specify the accreditation body's accreditation no. of RMP and CRM certificate no*)…. *(Specify* n*ame of the accreditation body)* is a signatory to the ILAC MRA (*or specify name of Regional Arrangement recognized by ILAC as appropriate*).

Appendix B (Informative) *- Electrical*

Issue date: xx month year
Valid until: xx month year

NO: SAMM XXX

LABORATORY LOCATION:
(PERMANENT LABORATORY)

ABC LABORATORY
NO.7A, JALAN 123
TAMAN PERINDUSTRIAN SEPANG
65200 SEPANG, SELANGOR
MALAYSIA

FIELD OF CALIBRATION: **ELECTRICAL**

This laboratory has demonstrated its technical competence to operate in accordance with MS ISO/IEC 17025:2017 (ISO/IEC 17025:2017).

This laboratory's fulfillment of the requirements of ISO/IEC 17025 means the laboratory meets both the technical competence requirements and management system requirements that are necessary for it to consistently deliver technically valid test results and calibrations. The management system requirements in ISO/IEC 17025 are written in language relevant to laboratory operations and operate generally in accordance with the principles of ISO 9001 (see Joint ISO-ILAC-IAF Communiqué dated April 2017).

*** The uncertainty covered by the CMC is expressed as the expanded uncertainty corresponding to a coverage probability of approximately 95 % and have a coverage factor of *k*=2 unless stated otherwise.**

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
DC VOLTAGE	220 mV (0 mV to ± 220 mV) 2.2 V (0 V to ± 2.2 V) 11 V (0 V to ± 11 V) 22 V (0 V to ± 22 V) 220V (0 V to ± 220 V) 1100 V (±100 V to ± 1100 V)	**(of reading + floor value)** 9 µV/V + 0.8 µV 8 µV/V + 1.2 µV 8 µV/V + 4 µV 8 µV/V + 8 µV 9 µV/V + 0.1 mV 11 µV/V + 0.6 mV	Generation using calibrator model Fluke 5700A.
AC VOLTAGE	2.2 mV to 220 V (See Matrix A) 1100 V 110 V to 1100 V 50 Hz to 1 kHz	(See Matrix A) 90 µV/V + 4 mV	Generation using calibrator model Fluke 5700A.

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
DC CURRENT	0 µA to ± 220 µA 0 mA to ± 2.2 mA 0 mA to ± 22 mA 0 mA to ± 220 mA 0 A to ± 1 A ±0.32 A to ± 3.2 A ±3.2 A to ± 10.5 A ±10.5 A to ± 20 A ±20 A to ± 100 A	60 µA/A + 0.01 µA 60 µA/A + 0.01 µA 60 µA/A + 0.1 µA 70 µA/A + 1 µA 95 µA/A + 30 µA 0.6 mA/A + 0.12 mA 0.55 mA/A + 0.94 mA 0.55 mA/A + 4.5 mA 0.45 mA/A + 20 mA	Generation using calibrator model Fluke 5700A.
AC CURRENT	9 µA to 2.2 A (See Matrix B) 0.32001 A to 3.2 A 10 Hz to 3 kHz 3 kHz to 10 kHz 3.2001 A to 10.5 A 10 Hz to 3 kHz 3 kHz to 10 kHz 20 A to 10.5 A 10 Hz to 3 kHz 3 kHz to 10 kHz	(See Matrix B) 1 mA/A + 0.48 mA 2.5 mA/A + 2.6 mA 2 mA/A + 6.9 mA 5 mA/A + 23 mA 2.5 mA/A + 0.03 A 5 mA/A + 0.05 A	Generation using calibrator model Fluke 5700A.

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
DC RESISTANCE Specific Values	1 mΩ 10 mΩ 100 mΩ 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ 1 GΩ 10 GΩ 100 GΩ 1 TΩ	0.2 mΩ/Ω 0.1 mΩ/Ω 0.02 mΩ/Ω 5 µΩ/Ω 0.11 mΩ/Ω 5 µΩ/Ω 31 µΩ/Ω 5 µΩ/Ω 0.02 mΩ/Ω 5 µΩ/Ω 15 µΩ/Ω 5 µΩ/Ω 14 µΩ/Ω 5 µΩ/Ω 15 µΩ/Ω 5 µΩ/Ω 24 µΩ/Ω 5 µΩ/Ω 0.05 mΩ/Ω 0.13 mΩ/Ω 5 µΩ/Ω 0.02 Ω/Ω 0.05 Ω/Ω 0.05 Ω/Ω	Generation using calibrator model Fluke 5700A.

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
DC RESISTANCE Specific Values	1 mΩ 10 mΩ 100 mΩ 1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ 1 GΩ 10 GΩ 100 GΩ 1 TΩ	25 µΩ/Ω 15 µΩ/Ω 7 µΩ/Ω 2.4 µΩ/Ω 2.4 µΩ/Ω 1.6 µΩ/Ω 1.6 µΩ/Ω 0.4 µΩ/Ω 2.4 µΩ/Ω 5.7 µΩ/Ω 6.8 µΩ/Ω 48 µΩ/Ω 270 µΩ/Ω 0.10% 0.10% 0.10%	Measurement of resistors with negligible power dissipation. Measurement of 1 mΩ to 100 mΩ in temperature controlled oil bath at 25 ºC. Measurement of 1 Ω to 1 GΩ in air at 23 ºC. Measurement of 10 GΩ to 1 TΩ at test voltages of 100 V, 250 V and 500 V.

SCOPE OF CALIBRATION: ELECTRICAL

Matrix A
AC Voltage Measurement

Range		Frequency (of reading + floor value)							
		Hz		kHz		MHz			
		10 to 20	20 to 40	0.04 to 20	20 to 50	0.05 to 0.1	0.1 to 0.3	0.3 to 0.5	0.5 to 1
2.2 mV	**0.22 mV to 2.2 mV**	0.6 + 0.005	0.24 + 0.005	0.12 + 0.005	0.41 + 0.005	0.95 + 0.008	1.3 + 0.015	1.8 + 0.03	3.6 + 0.03
22 mV	**2.2 mV to 22 mV**	0.6 + 0.006	0.24 + 0.006	0.12 + 0.006	0.41 + 0.006	0.95 + 0.008	1.3 + 0.015	1.8 + 0.03	3.6 + 0.03
220 mV	**22 mV to 220 mV**	0.6 + 0.016	0.24 + 0.01	0.11 + 0.01	0.36 + 0.01	0.9 + 0.03	1.1 + 0.03	1.8 + 0.04	3.6 + 0.1
2.2 V	**0.22 V to 2.2 V**	0.6 + 0.1	0.18 + 0.03	0.085 + 0.007	0.14 + 0.02	0.28 + 0.08	0.48 + 0.15	1.2 + 0.4	2.4 + 1
22 V	**2.2 V to 22 V**	0.6 + 1	0.18 + 0.3	0.085 + 0.07	0.14 + 0.2	0.28 + 0.4	0.6 + 1.7	1.4 + 5	3 + 9
220 V	**22 V to 220 V**	0.6 + 10	0.18 + 3	0.09 + 1	0.25 + 4	0.6 + 10	1.6 + 110	5.4 + 110	13 + 220

Matrix B
AC Current Measurement

Range	Frequency (kHz)				
	0.01 to 0.02	0.02 to 0.04	0.04 to 1	1 to 5	5 to 10
9 µA to 220 µA	0.8 + 0.03	0.42 + 0.025	0.16 + 0.02	0.7 + 0.05	1.8 + 0.1
0.22 mA to 2.2 mA	0.8 + 0.05	0.42 + 0.04	0.16 + 0.04	0.7 + 0.5	1.8 + 1
2.2 mA to 22 mA	0.8 + 0.5	0.42 + 0.4	0.16 + 0.4	0.7 + 10	1.8 + 0.01
22 mA to 220 mA	0.8 + 5	0.42 + 4	0.18 + 4	0.7 + 50	1.8 + 100
0.22 A to 2.2 A	-	-	0.75 + 40	0.85 + 100	10 + 200

Signatories:

1. XYZ
2. DEF

LABORATORY LOCATION:
(PERMANENT LABORATORY)

ABC LABORATORY SDN. BHD.
NO.7A, JALAN 123
TAMAN PERINDUSTRIAN SEPANG
65200 SEPANG, SELANGOR
MALAYSIA

FIELD OF CALIBRATION: **TEMPERATURE & HUMIDITY**

This laboratory has demonstrated its technical competence to operate in accordance with MS ISO/IEC 17025:2017 (ISO/IEC 17025:2017).

This laboratory's fulfillment of the requirements of ISO/IEC 17025 means the laboratory meets both the technical competence requirements and management system requirements that are necessary for it to consistently deliver technically valid test results and calibrations. The management system requirements in ISO/IEC 17025 are written in language relevant to laboratory operations and operate generally in accordance with the principles of ISO 9001 (see Joint ISO-ILAC-IAF Communiqué dated April 2017).

*** The uncertainty covered by the CMC is expressed as the expanded uncertainty corresponding to a coverage probability of approximately 95 % and have a coverage factor of *k*=2 unless stated otherwise.**

SCOPE OF CALIBRATION: TEMPERATURE

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
LIQUID-IN-GLASS THERMOMETER			
Total Immersion	-80 °C to 0 °C 0 °C to 90 °C 90 °C to 250 °C	0.05 °C 0.06 °C 0.10 °C	Comparison with PT100 reference in: alcohol bath water bath oil bath
Partial Immersion	-80 °C to 0 °C 0 °C to 90 °C 90 °C to 250 °C	0.05 °C 0.06 °C 0.10 °C	Comparison with PT100 reference in: alcohol bath water bath oil bath

SCOPE OF CALIBRATION: TEMPERATURE

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
RESISTANCE TEMPERATURE DETECTOR			
Std Pt Res. Thermometer	-80 °C to 0 °C 0 °C to 250 °C 250 °C to 400 °C 400 °C to 600 °C 600 °C to 900 °C	0.01 °C 0.01 °C 0.04 °C 0.04 °C 0.05 °C	Comparison with Standard Resistance Thermometers in: alcohol bath water bath oil bath calibration furnace
Digital Thermometer with PT100 Probe	80 °C to 0 °C 0 °C to 90 °C 90 °C to 250 °C 250 °C to 660 °C	0.05 °C 0.05 °C 0.10 °C 0.40 °C	Comparison with Standard Resistance Thermometers in: alcohol bath water bath oil bath calibration furnace
RADIATION THERMOMETER			
All types of Radiation Thermometer	50 °C to 0 °C 0 °C to 250 °C 250 °C to 1000 °C 1100 °C to 1600 °C	1.0 °C 1.2 °C 1.5 °C 2.5 °C	Comparison with Standard Thermocouple or Standard Radiation Thermometer in calibration bath or calibration furnace
THERMOCOUPLE			
Thermocouple of all types	50 °C to 0 °C 0 °C to 250 °C	0.3 °C 0.3 °C	Comparison with Standard Thermocouple in calibration bath
	200 °C to 1000 °C 1100 °C to 1600 °C	0.6 °C 2.5 °C	Comparison with Standard Thermocouple in calibration furnace
Temperature indicator / recorder / controller	-270 °C to 400 °C -200 °C to 1000 °C -50 °C to 1300 °C 0 °C to 1800 °C	0.3 °C 0.3 °C 0.6 °C 2.5 °C	By electrical simulation using calibrator and reference table to ITS- 90

Signatory:
1. ABC

SCOPE OF CALIBRATION: HUMIDITY

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
TEMPERATURE & HUMIDITY INDICATOR			
Thermohygrometer	Refer to Matrix A	Refer to Matrix A	Comparison with Chilled Mirror Dew Point Hygrometer in humidity chamber
Thermohygrograph	Refer to Matrix B	Refer to Matrix B	Comparison with Chilled Mirror Dew Point Hygrometer in humidity chamber
Dew Point Meter	-80 °C to 40 °C	1.0 °C	Comparison with Chilled mirror Dew Point hygrometer

Signatories:
1. ABC
2. DEF

SCOPE OF CALIBRATION: HUMIDITY

Matrix A

@ Temperature	23 °C		30 °C		50 °C	
Resolution (%rh) / %rh	**0.1**	**1**	**0.1**	**1**	**0.1**	**1**
10	0.7	1	0.8	1	0.9	1
20	0.7	1	0.8	1	0.9	1
30	0.8	1	0.9	1	1.0	2
40	0.9	1	0.9	1	1.0	2
50	0.9	1	1.0	1	1.2	2
60	1.0	1	1.1	1	1.2	2
70	1.1	1	1.2	1	1.3	2
80	1.2	2	1.4	2	1.4	2
95	1.4	2	1.5	2	1.5	2

Matrix B

@ Temperature	23 °C			30 °C		
Graduation (%rh) / %rh	**1**	**2**	**5**	**1**	**2**	**5**
10	1	2	3	1	2	3
20	1	2	3	1	2	3
30	1	2	3	1	2	3
40	1	2	3	2	2	3
50	1	2	3	2	2	3
60	1	2	3	2	2	3
70	2	2	3	2	2	3
80	2	2	3	2	2	3
95	2	2	3	2	2	3

The expanded uncertainties given in these tables are expressed in **%rh**

SCOPE OF CALIBRATION: TEMPERATURE

SITE: CATEGORY 1

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
ENCLOSURES			
Freezer	-80 °C to 0 °C	0.3 °C	Based on AS 2853
Water Bath	0 °C to 90 °C	0.5 °C	
Temperature	90 °C to 250 °C	0.7 °C	
Chamber	250 °C to 660 °C	1.0 °C	
Autoclaves	600 °C to 1300 °C	1.5 °C	
Oven			

Signatories:
1. CED
2. EFG

Appendix D (Informative) *- Dimensional*

Issue date: xx month year
Valid until: xx month year

NO: SAMM XXX

LABORATORY LOCATION:
(PERMANENT LABORATORY)

ABC LABORATORY SDN. BHD.
NO.7A, JALAN 123
TAMAN PERINDUSTRIAN SEPANG
65200 SEPANG, SELANGOR
MALAYSIA

FIELD OF CALIBRATION: **DIMENSIONAL**

This laboratory has demonstrated its technical competence to operate in accordance with MS ISO/IEC 17025:2017 (ISO/IEC 17025:2017).

This laboratory's fulfillment of the requirements of ISO/IEC 17025 means the laboratory meets both the technical competence requirements and management system requirements that are necessary for it to consistently deliver technically valid test results and calibrations. The management system requirements in ISO/IEC 17025 are written in language relevant to laboratory operations and operate generally in accordance with the principles of ISO 9001 (see Joint ISO-ILAC-IAF Communiqué dated April 2017).

*** The uncertainty covered by the CMC is expressed as the expanded uncertainty corresponding to a coverage probability of approximately 95 % and have a coverage factor of *k*=2 unless stated otherwise.**

SCOPE OF CALIBRATION: DIMENSIONAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
MICROMETERS			Calibrated using ceramic gauge block as standards according to JIS 5602. Setting rod must be provided by customer
External 25 mm frame 50 mm frame and above	Up to 25 mm 25 mm travel	0.7 μm 1.2 μm	
Internal	Up to 25 mm 25 mm to 50 mm	0.8 μm 2 μm	
CALIPERS			Calibrated using caliper checker for length up to 300 mm. Calibrated using gauge block for length above 300 mm.
Internal and External	Up to 300 mm 300 mm to 500 mm	5 μm 10 μm	

SCOPE OF CALIBRATION: DIMENSIONAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
GAUGE BLOCKS Steel	Up to 100 mm	Q[a,b] μm	Calibrated according to ISO 3650 (central length, variation in length)
DIAMETER Internal Cylinder (Diameter only)	Up to 50 mm 50 mm to 100 mm	0.6 μm 1.0 μm	Contact method using universal Mahr UMM with master ring gauge
External Cylinder (Diameter only)	Up to 50 mm 50 mm to 100 mm	0.5 μm 1.0 μm	Contact method using universal Mahr UMM with master cylinder gauge
Sphere (Diameter only)	Up to 50 mm	5 μm	Calibrated using Mahr UMM with master sphere standard
SURFACE PLATE Overall flatness	Up to 200 mm x 200mm Up to 1000 mm x 1000 mm	10 μm 20 μm	Calibrated using planekator
Line scale (line spacing)	Up to 500 mm	2 μm	Direct measurement using laser interferometer

Signatory:
1. ABC

LABORATORY LOCATION:
(PERMANENT LABORATORY)

ABC LABORATORY SDN. BHD.
NO.7A, JALAN 123
TAMAN PERINDUSTRIAN SEPANG
65200 SEPANG, SELANGOR
MALAYSIA

FIELD OF CALIBRATION: **MASS & MASS RELATED QUANTITIES**

This laboratory has demonstrated its technical competence to operate in accordance with MS ISO/IEC 17025:2017 (ISO/IEC 17025:2017).

This laboratory's fulfillment of the requirements of ISO/IEC 17025 means the laboratory meets both the technical competence requirements and management system requirements that are necessary for it to consistently deliver technically valid test results and calibrations. The management system requirements in ISO/IEC 17025 are written in language relevant to laboratory operations and operate generally in accordance with the principles of ISO 9001 (see Joint ISO-ILAC-IAF Communiqué dated April 2017).

*** The uncertainty covered by the CMC is expressed as the expanded uncertainty corresponding to a coverage probability of approximately 95 % and have a coverage factor of *k*=2 unless stated otherwise.**

SCOPE OF CALIBRATION: FORCE

Instrument Calibrated/ Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
Load proving devices, load cells, and other force-measuring devices:			1. The uncertainty figures include the contribution from the device being calibrated.
Compression and Tension Modes	0.5 kN to 5 kN above 5 kN to 10 kN above 10 kN to 50 kN	0.006% of reading 0.009% of reading 0.02% of reading	2. Forces may be applied by increment and decrement and the hysterisis errors determined.
Compression Mode only	above 50 kN to 300 kN	0.05% of reading	3. The calibration procedure used may be either in accordance with ISO 376 or ASTM E74. 4. Calibrations may be made in terms of Newton (N), or kilogram-force (kgf).

Signatory:
1. ABC

SCOPE OF CALIBRATION: MASS

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*		Remarks
		Permanent	Site	
MASS	Nominal Value			
Standard weights	1 g	0.04 mg	-	1. Calibrations may be given in other units by conversion from SI units. 2. Intermediate values can be calibrated with uncertainty interpolated from the next higher and lower nominal values tabulated.
	2 g	0.08 mg	-	
	5 g	0.15 mg	-	
	10 g	0.3 mg	-	
	20 g	0.6 mg	-	
	50 g	1.5 mg	-	
	100 g	3 mg	-	
	200 g	6 mg	-	
	500 g	15 mg	-	
	1 kg	30 mg	45 mg	
	2 kg	-	60 mg	
	5 kg	-	1.5 g	
	10 kg	-	3 g	
	20 kg	-	6 g	

Signatory:
1. ABC

SCOPE OF CALIBRATION: MASS

SITE: CATEGORY 1

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
MASS			
Weighing balances and scales	Up to 200 g Up to 300 g Up to 500 g Up to 1 kg Up to 1.5 kg Up to 2 kg Up to 2.5 kg Up to 3 kg Up to 3.5 kg Up to 4 kg Up to 4.5 kg Up to 5 kg	0.30 mg 0.35 mg 0.75 mg 1.5 mg 3.0 mg 1.5 mg 2.5 mg 4.0 mg 4.5 mg 5.0 mg 6.0 mg 7.5 mg	1. The calibration procedure covers tests on instrumental error, repeatability and eccentric loading. 2. The CMC has been evaluated based on uncertainty contributions from the three tests, and the standards used. 3. Weighing balances and scales with ranges intermediate from the values tabulated can be calibrated with uncertainty interpolated from the next higher and lower range values.

Signatory:
1. ABC