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LABORATORY LOCATION:
(PERMANENT LABORATORY)

NATIONAL METROLOGY INSTITUTE OF MALAYSIA
SIRIM BERHAD
LOT PT 4803, BANDAR BARU SALAK TINGGI
43900 SEPANG, SELANGOR
MALAYSIA

FIELD(S) OF CALIBRATION: **MASS, PRESSURE, FORCE, VOLUME, DENSITY, FLOW, VISCOSITY, DIMENSIONAL, ELECTRICAL, TIME & FREQUENCY, VIBRATION, ACOUSTIC, PHOTOMETRY & RADIOMETRY, TEMPERATURE, HUMIDITY, CHEMICAL**

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: **MASS MEASUREMENTS**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Standard Weights	1 mg 2 mg 5 mg 10 mg 20 mg 50 mg 100 mg 200 mg 500 mg	0.0006 mg 0.0006 mg 0.0008 mg 0.0008 mg 0.0010 mg 0.0012 mg 0.0014 mg 0.0015 mg 0.0015 mg	Direct comparison against standard weights using mass comparator

SCOPE OF CALIBRATION: MASS MEASUREMENTS

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Standard Weights	1 g 2 g 5 g 10 g 20 g 50 g 100 g 200 g 500 g 1 kg 2 kg 5 kg 10 kg 20 kg	0.002 mg 0.004 mg 0.005 mg 0.007 mg 0.008 mg 0.010 mg 0.020 mg 0.035 mg 0.075 mg 0.15 mg 0.33 mg 0.90 mg 1.6 mg 6 mg	Direct comparison against standard weights using mass comparator

Signatories:

1. **Ts.Suliana Binti Ghazalli**
2. **Suhaidah Binti Amizam**
3. **Muhammad Fadhil Bin Shahrom (only for OIML Class F1 and below)**

SCOPE OF CALIBRATION: **MASS MEASUREMENTS**

SITE CALIBRATION: **CATEGORY I**

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Electronic Balances	Up to 5 g	0.005 mg	Calibrated using standard weights
	Up to 20 g	0.010 mg	
	Up to 200 g	0.05 mg	
	Up to 1 kg	0.25 mg	
	Up to 2 kg	0.51 mg	
	Up to 5 kg	1.2 mg	
	Up to 10 kg	10 mg	
	Up to 30 kg	12 mg	
	Up to 60 kg	100 mg	

Signatories:

1. **Ts. Suliana Binti Ghazalli**
2. **Suhaidah Binti Amizam**
3. **Muhammad Fadhil Bin Sahrom**

SCOPE OF CALIBRATION: PRESSURE MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Gauge pressure (P_e), Pneumatic Pressure gauge, Electromechanical manometer	1.4 kPa to 180 kPa >180 kPa to 700 kPa >700 kPa to 8 MPa >8 MPa to 40 MPa	$2.6\times10^{-5}\times P_e$, not less than 0.00047 kPa $3.1\times10^{-5}\times P_e$, not less than 0.0021 kPa $2.7\times10^{-5}\times P_e$, not less than 0.021 kPa $4.4\times10^{-5}\times P_e$	Direct comparison with the pressure standard
Gauge pressure (P_e), Hydraulic Pressure gauge, Electromechanical manometer	340 kPa to 4 MPa >4 MPa to 50 MPa >50 MPa to 80 MPa >80 MPa to 138 MPa >138 MPa to 500 MPa	$3.7\times10^{-5}\times P_e$, not less than 0.10 kPa $3.8\times10^{-5}\times P_e$, not less than 0.19 kPa $4.1.0\times10^{-5}\times P_e$, not less than 0.33 kPa $4.4\times10^{-5}\times P_e$, not less than 0.60 kPa $8.3\times10^{-5}\times P_e$	
Gauge pressure (P_e), Pneumatic Pressure balance	1.4 kPa to 180 kPa >180 kPa to 400 kPa >400 kPa to 8 MPa >8 MPa to 40 MPa	$5.4\times10^{-5}\times P_e$, not less than 0.00097 kPa $5.6\times10^{-5}\times P_e$, not less than 0.0039 kPa $4.0\times10^{-5}\times P_e$, not less than 0.032 kPa $4.9\times10^{-5}\times P_e$	Direct comparison with pressure standard: cross-floating method
Gauge pressure (P_e), Hydraulic Pressure balance	340 kPa to 3 MPa >3 MPa to 50 MPa >50 MPa to 80 MPa >80 MPa to 138 MPa >138 MPa to 500 MPa	$3.9\times10^{-5}\times P_e$, not less than 0.11 kPa $3.9\times10^{-5}\times P_e$, not less than 0.19 kPa $6.5\times10^{-5}\times P_e$, not less than 0.52 kPa $8.6\times10^{-5}\times P_e$, not less than 1.18 kPa $1.0\times10^{-4}\times P_e$	

Signatories:

1. **Ts. Mohd Mazid Bin Mansor**
2. **Ahmad Zamir Bin Zulkifli (except calibration by cross-floating method)**

SCOPE OF CALIBRATION: FORCE MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Elastic Force Measuring Instruments (Compression Mode)	0.5 kN to 60 kN	0.004 % of reading	Dead Weight Force Standard Machine, 60 kN
Elastic Force Measuring Instruments (Compression Mode)	0.5 kN to 100 kN	0.05 kN	Force Transducer, 50 & 100 kN
	100 kN to 270 kN	0.4 kN	Proving Ring, 300 kN
	270 kN to 2000 kN	2.0 kN	Proving Rings, 600 kN & 2000 kN

Signatory:

1. **Ali Imran Bin Abdul Hapip**

SCOPE OF CALIBRATION: VOLUME MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Volumetric apparatus 'to deliver'	2 mL to 50 mL 50 mL to 500 mL 500 mL to 20000 mL	2×10^{-3} mL 2.1×10^{-2} mL 2.1×10^{-1} mL	Calibration with general reference to ISO 4787:2021 (E) and Euramet cg-21 Ver 1.0
Volumetric apparatus 'to contain'	10 mL to 100 mL 100 mL to 500 mL 500 mL to 2000 mL 2000 mL to 25000 mL	2×10^{-3} mL 6×10^{-3} mL 4.3×10^{-2} mL 4.5×10^{-1} mL	Calibration with general reference to ISO 4787:2021 (E) and Euramet cg-21 Ver 1.0

Signatories:

1. **Ts. Syahrul Bin Manap**
2. **Kamarudin Bin Mohamad Nor**

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Prover Tank	20 L to 454 L	0.006 L	Calibrated By Gravimetric Method

Signatories:

1. **Ts. Syahrul Bin Manap**
2. **Ts.Hafidzi Bin Hamdan**

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Gas Meter	50 – 6000 L/h	0.25%	Calibrated By Comparison Method with Master Gas Meter

Signatories:

1. **Ts. Syahrul Bin Manap**
2. **Khairul Aswadi Bin Che Awang**

SCOPE OF CALIBRATION: DENSITY MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Specific Gravity Hydrometer	0.600 to 1.000	0.00013	Reference by standard density liquid
Density Hydrometer	(600 to 1000) kgm^{-3}	0.13 kgm^{-3}	
Specific Gravity Hydrometer	1.000 to 2.000	0.00014	
Density Hydrometer	(1000 to 2000) kgm^{-3}	0.14 kgm^{-3}	

Signatories:

1. **Ts. Dr. Mohd Fazrulhisyam Bin Mohd Nor**
2. **Noor Razinah Binti Rahmat**

SCOPE OF CALIBRATION: FLOW

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Anemometer	3 – 10 m/s 11 – 24 m/s 25 – 30 m/s	0.07 m/s 0.14 m/s 0.24 m/s	Comparison method using Pitot Static Tubes based on ISO 3966:2020

Signatories:

1. **Ts. Syahrul Bin Manap**
2. **Muhammad Asyraf Bin Abdul Aziz**

SCOPE OF CALIBRATION: VISCOSITY MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Glass Capillary Viscometer	(0.3 to 1.5) mm^2/s (1.5 to 10) mm^2/s (10 to 160) mm^2/s (160 to 1000) mm^2/s (1000 to 70000) mm^2/s	0.15 % 0.19 % 0.20 % 0.21 % 0.22 %	ASTM D446-04 DIN 51562-1 to 4 The viscometer constant covering the listed kinematic viscosity range was determined using the viscosity standard liquid
Viscosity Standard Liquid	Kinematic viscosity range: (0.3 to 1.5) mm^2/s (1.5 to 10) mm^2/s (10 to 160) mm^2/s (160 to 1000) mm^2/s (1000 to 100000) mm^2/s Dynamic viscosity range: (0.3 to 1.5) mPa.s (1.5 to 10) mPa.s (10 to 160) mPa.s (160 to 1000) mPa.s (1000 to 100000) mPa.s	0.18 % 0.22 % 0.23 % 0.24 % 0.25 % 0.22 % 0.25 % 0.26 % 0.27 % 0.27 %	The viscosity of the standard liquid was measured using a standard glass capillary viscometer ASTM D446-04 Din51562- 1 to 4
Viscosity Cup / Flow Cup	(5 to 2000) mm^2/s	1.0 %	The cup equation was determined using viscosity standard liquid

Signatory:

1. **Zukhairi Bin Anuar**

SCOPE OF CALIBRATION: DIMENSIONAL MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
I_2 – Stabilised He-Ne Lasers	633 nm	24 kHz	Based on Optical Beat Frequency Technique
Frequency-stabilised He-Ne Lasers	633 nm	0.6 MHz	Based on Optical Beat Frequency Technique

Signatories:

1. **Razman Bin Mohd Halim**

SCOPE OF CALIBRATION: DIMENSIONAL MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Gauge Blocks, Grades 00 (or equivalent) and above	L ≤ 300 mm	Q [30, 0.30L] nm, L in mm	Using interferometry technique
Long Gauge Blocks (Central length)	125 mm to 500 mm	Q [0.3, 0.001L] µm, L in mm	Using mechanical comparison method (Steel and reference with same material)
Long Gauge Blocks (Central length)	125 mm ≤ L ≤ 1000 mm 5 inch ≤ L ≤ 40 inch	Q [0.39 µm, 1.0E-6L] Q [15.4 µin, 1.0E-6L] L, represents length	Using mechanical comparison method (Steel and reference with same material)
Gauge Blocks (Central length)	0.5 mm ≤ L ≤100 mm 0.02 inch ≤ L ≤ 4 inch	Q [0.07 µm, 2.0E-6L] Q [2.8 µin, 2.0E-6L] L, represents length	Mechanical comparative method (Steel and reference with same material)
Gauge Blocks (Central length)	0.5 mm ≤ L ≤ 100 mm 0.02 inch ≤ L ≤ 4 inch	Q [0.07 µm,1.2E-6L] Q [2.8 µin,1.2E-6L] L, represents length	Mechanical comparative method (Tungsten Carbide and reference with same material)

SCOPE OF CALIBRATION: DIMENSIONAL MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Gauge Blocks (Central length)	0.5 mm ≤ L ≤ 100 mm 0.02 inch ≤ L ≤ 4 inch	Q [0.07 µm, 1.8E-6L] Q [2.8 µin, 1.8E-6L] L, represents length	Mechanical comparative method (Ceramic and reference with same material)

Signatories:

1. **Razman Bin Mohd Halim**
2. **Fareef Bin Sait**
3. **Rafidah Binti Rosli**

SCOPE OF CALIBRATION: DIMENSIONAL MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Diameter Standards (Internal diameter)	L ≤ 85 mm	Q [0.4, 0.02L] µm, L in mm	Using non-contact method

Signatories:

1. **Razman Bin Mohd Halim**
2. **Fareef Bin Sait**
3. **Mohd Hakimi Bin Othman**

SCOPE OF CALIBRATION: DIMENSIONAL MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Line Scale and Line Spacing	L ≤ 1000 mm	18 µm	Using length comparator

Signatories:

1. **Razman Bin Mohd Halim**
2. **Fareef Bin Sait**
3. **Mohammad Amirul Bin Ahmad Shukri.**

SCOPE OF CALIBRATION: DIMENSIONAL MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Length measuring instrument (Error of indicated size, displacement and position)	L ≤ 1000 mm	Q [0.21 µm, 1.0E-6L] L, represents length	Comparison with laser interferometer

Signatories:

1. **Razman Bin Mohd Halim**
2. **Fareef Bin Sait**

SCOPE OF CALIBRATION: DIMENSIONAL MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Angle Gauge Blocks	0° to 90°	0.70 arcsec	Using indexing table as reference and autocollimator
Optical polygon (face angle)	0° to 360°	0.58 arcsec	Using indexing table as reference and autocollimator
Rotary table (error of indicated angle)	0° to 360°	1.0 arcsec	Using optical polygon as reference and autocollimator

1. **Razman Bin Mohd Halim**
2. **Rafidah Binti Rosli**
3. **Mohammad Amirul Bin Ahmad Shukri**

SCOPE OF CALIBRATION: **DIMENSIONAL**

SITE CALIBRATION: **CATEGORY I**

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Gauge Block Comparator	Up to 100 mm	0.05 µm	EUROMET cg-2Version 2.0

Signatories:

1. **Razman Bin Mohd Halim**
2. **Rafidah Binti Rosli**

SCOPE OF CALIBRATION: **DIMENSIONAL MEASUREMENTS**

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Laser distance measuring instrument: Error of indicated distance *L*	L ≤ 25 m	Q [0.87 mm, 12.5E-6L] L, represents length	Laser interferometer bench system
Precision line scale: Line spacing *L*	0.1 mm ≤ L ≤ 800 mm	Q [0.37 µm, 1.3E-6L] L, represents length	Comparison with laser interferometer and CCD microscope
Tape: Line spacing *L*	L ≤ 25 m	Q [0.03 mm, 11.8E-6L] L, represents length	Laser interferometer bench system with CCD camera

Signatories:

1. **Razman Bin Mohd Halim**
2. **Fareef Bin Sait**

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Surface Texture (Depth Standard D, Type A)	Up to 131 µm	[8.8 nm, 17E-0.36D] D,represents groove depth	ISO 5436-1 Stylus instrument
Surface Texture (Roughness standard C, D, Ra)	Up to 131 µm	[9.8 nm, 17E-3Ra] Ra,represents roughness value	ISO 4287, ISO 4288 Stylus instrument
Surface Texture (Roughness standard C, D, Rz)	Up to 131 µm	[25 nm, 36E-3Rz] Rz, represents roughness value	ISO 4287, ISO 4288 Stylus instrument

Signatories:

1. **Razman Bin Mohd Halim**
2. **Sheikh Ikmal Aizad Bin Sheikh Ahmad Zabani**

SCOPE OF CALIBRATION: ELECTRICAL MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
DC VOLTAGE DC Voltage Sources : single values	1 V 1.018 V 10 V	0.2 µV 0.2 µV 0.6 µV	Calibrated using Zener Voltage standard Fluke 732B.
	1.018 V 10 V	70 nV 90 nV	Calibrating Zener Voltage Standard using Josephson Junction array voltage Standard

Signatories:

1. **Nazri Bin Marzuki**
2. **Ts. Dr. Shakirah Binti Mohd Amran**
3. **Syarizal Bin Zainal Abidin**

SCOPE OF CALIBRATION: ELECTRICAL MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
DC RESISTANCE DC Resistance Sources : single values	1 mΩ 10 mΩ 100 mΩ	5 μΩ/Ω 5 μΩ/Ω 4 μΩ/Ω	DCC Bridge with Current Extender
	1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ	0.3 μΩ/Ω 0.3 μΩ/Ω 0.3 μΩ/Ω 1.8 μΩ/Ω 0.3 μΩ/Ω 3 μΩ/Ω 4 μΩ/Ω 5 μΩ/Ω	DCC Bridge DCC Bridge and Hamon Devices
	100 MΩ 1 GΩ 10 GΩ 100 GΩ 1 TΩ	11 μΩ/Ω 21 μΩ/Ω 28 μΩ/Ω 60 μΩ/Ω 580 μΩ/Ω	Modified Wheatstone Bridge
DC RESISTANCE DC Resistance Sources : decade value	1 mΩ to 1 Ω 1 Ω to 10 Ω 10 Ω to 100 Ω 100 Ω to 1 kΩ 1 kΩ to 10 kΩ 10 kΩ to 100 kΩ 100 kΩ to 1 MΩ 1 MΩ to 10 MΩ 10 MΩ to 100 MΩ 100 MΩ to 1 GΩ 1 GΩ to 10 GΩ	39 μΩ/Ω 33 μΩ/Ω 21 μΩ/Ω 15 μΩ/Ω 15 μΩ/Ω 15 μΩ/Ω 20 μΩ/Ω 70 μΩ/Ω 600 μΩ/Ω 200 μΩ/Ω 200 μΩ/Ω	Direct measurement using high resolution DMM
DC Resistance Indicating Meters	10 MΩ 100 MΩ 1G Ω 10 GΩ 100 GΩ 1 TΩ	60 μΩ/Ω 60 μΩ/Ω 70 μΩ/Ω 100 μΩ/Ω 100 μΩ/Ω 1 mΩ/Ω	Calibrated using High Value Standard Resistors

SCOPE OF CALIBRATION: ELECTRICAL MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
DC CURRENT			
DC Current Sources	10 μA to 100 μA 100 μA to 1 mA 1 mA to 10 mA 10 mA to 100 mA 100 mA to 1 A 1 A to 10 A 10 A to 20 A 20 A to 50 A 50 A to 100 A	11 μA/A 11 μA/A 11 μA/A 11 μA/A 20 μA/A 21 μA/A 100 μA/A 100 μA/A 100 μA/A	Voltage drop across a resistor
DC VOLTAGE			
DC Voltage Sources	0.1 V to 1 V 1 V to 1000 V	0.9 μV/V 0.8 μV/V	Using Volt Ratio Box

Signatories:

1. **Nazri Bin Marzuki**
2. **Nirul Irwani Binti Ishak**

SCOPE OF CALIBRATION: ELECTRICAL MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
DC Voltage Indicating Meters	1 mV 10 mV 100 mV 1 V 10 V 100 V 1000 V	408 µV/V 48 µV/V 12µV/V 6 µV/V 4 µV/V 5 µV/V 7 µV/V	Using 5720A Calibrator
DC RESISTANCE DC Resistance Sources Multiple Ranges	1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ	8 µΩ/Ω 5 µΩ/Ω 2 µΩ/Ω 4 µΩ/Ω 4 µΩ/Ω 4 µΩ/Ω 5 µΩ/Ω 20 µΩ/Ω 180 µΩ/Ω	Using characterized Reference Multimeter
DC CURRENT DC Current Indicating Meters	100 µA 1 mA 10 mA 100 mA 1 A 10 A	110 µA/A 50 µA/A 40 µA/A 60 µA/A 100 µA/A 410 µA/A	Using 5720A Calibrator

SCOPE OF CALIBRATION: ELECTRICAL MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
AC Voltage AC/DC voltage transfer difference	(See Matrix A)	(See Matrix A)	AC/DC direct comparison with thermal voltage converters.

Frequency / Voltage	Hz					kHz								MHz				
	10	**20**	**30**	**40**	**57**	**0.1**	**0.4**	**1**	**5**	**10**	**20**	**30**	**50**	**0.1**	**0.2**	**0.3**	**0.5**	**1**
1 V	10	8	7	7	7	7	7	7	7	7	7	8	8	11	15	19	24	38
2 V	13	8	5	6	5	5	5	5	5	6	6	6	6	8	10	14	18	28
3 V	10	7	6	5	5	5	5	5	5	6	6	6	7	8	11	14	19	29
4 V	11	8	7	6	6	6	6	6	6	6	6	7	8	10	13	17	22	34
6 V	12	8	7	7	7	7	7	7	7	7	7	8	8	11	16	21	27	45
10 V	11	8	7	7	7	7	7	7	7	7	7	8	8	11	16	21	27	45
12 V	11	8	7	7	7	7	7	7	7	7	8	8	9	12	17	22	29	49
20 V	13	9	8	8	8	8	8	8	8	8	8	9	9	13	19	26	34	-
30 V	12	9	8	8	8	8	8	8	9	9	9	10	11	15	20	27	35	-
40 V	12	9	9	8	8	8	8	8	9	9	9	10	11	16	21	29	-	-
60 V	13	10	9	9	9	9	9	9	10	10	10	11	12	17	-	-	-	-
100 V	12	10	9	9	9	9	9	9	10	10	10	11	13	17	-	-	-	-
120 V	13	11	10	10	10	10	10	10	10	10	11	11	14	18	-	-	-	-
200 V	14	11	11	10	10	10	10	10	11	11	11	12	14	20	-	-	-	-
300 V	15	12	12	11	11	11	11	11	11	11	12	13	16	23	-	-	-	-
400 V	15	13	12	12	12	12	12	12	12	12	13	15	19	27	-	-	-	-
600 V	16	14	14	14	14	14	14	14	15	15	17	19	26	36	-	-	-	-
1000 V	16	15	15	15	15	15	15	15	17	17	19	23	32	45	-	-	-	-

Matrix A

The expanded uncertainties given in this table are expressed in µV/V.

SCOPE OF CALIBRATION: ELECTRICAL MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
AC Voltage AC voltage source	(See Matrix B)	(See Matrix B)	AC/DC comparison method using AC/DC transfer standard.

Frequency / Voltage	Hz					kHz								MHz				
	10	**20**	**30**	**40**	**57**	**0.1**	**0.4**	**1**	**5**	**10**	**20**	**30**	**50**	**0.1**	**0.2**	**0.3**	**0.5**	**1**
1 V	18	12	10	10	13	10	10	9	9	9	11	13	23	37	27	28	38	49
2 V	17	12	10	9	9	10	9	7	9	11	10	8	11	14	14	18	22	32
3 V	15	9	12	8	10	11	11	8	8	14	18	16	23	23	22	23	27	38
4 V	18	14	13	12	81	13	11	10	11	12	10	12	13	16	19	21	25	39
6 V	18	12	13	13	12	13	12	11	14	12	13	13	14	15	19	24	32	51
10 V	21	22	19	19	19	16	17	18	20	21	22	17	24	22	24	30	34	53
12 V	16	13	12	12	11	13	12	12	11	12	13	13	14	16	20	26	34	-
20 V	19	14	12	14	12	12	11	12	15	13	12	13	14	18	25	30	39	-
30 V	25	19	17	13	17	18	16	14	13	13	13	14	25	24	29	36	-	-
40 V	19	13	14	13	13	14	13	13	14	14	14	15	14	21	27	-	-	-
60 V	19	15	15	14	15	15	14	14	16	15	14	17	17	21	-	-	-	-
100 V	21	25	18	21	18	20	20	16	23	21	19	19	20	28	-	-	-	-
120 V	17	13	13	13	13	12	13	13	13	12	15	13	16	21	-	-	-	-
200 V	17	13	13	12	12	12	12	12	13	13	13	14	17	24	-	-	-	-
300 V	-	-	-	14	14	18	14	15	14	14	15	16	-	-	-	-	-	-
400 V	-	-	-	15	14	14	14	14	14	14	15	17	-	-	-	-	-	-
600 V	-	-	-	16	16	16	16	16	17	17	19	22	-	-	-	-	-	-
1000 V	-	-	-	17	18	17	17	18	19	19	20	26	-	-	-	-	-	-

Matrix B

The expanded uncertainties given in this table are expressed in µV/V.

SCOPE OF CALIBRATION: ELECTRICAL MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
AC Voltage AC voltage indicating meter	2 mV to 1000 V (See Matrix C)	2 mV to 1000 V (See Matrix C)	AD/DC transfer method using AC/DC Transfer Standard

Frequency / Voltage	10 Hz	20 Hz	100 Hz	1 kHz	10 kHz	20 kHz	50 kHz	100 kHz	300 kHz	500 kHz	1 MHz
2 mV	210	210	270	210	210	210	410	760	1510	2260	2260
6 mV	80	70	90	70	80	70	140	260	510	760	750
20 mV	30	20	30	20	20	20	30	30	50	160	160
60 mV	220	100	50	50	50	60	110	160	460	610	620
200 mV	210	90	50	50	50	50	110	160	460	610	620
600 mV	210	80	30	30	30	30	50	70	150	440	560
2 V	210	70	20	20	20	20	50	60	130	440	460
6 V	210	70	20	20	20	20	50	60	130	450	530
20 V	210	70	20	20	20	20	50	60	130	460	600
60 V	210	70	30	30	30	30	60	70	140	-	-
200 V	210	70	40	40	40	40	70	80	-	-	-
600 V	-	-	50	50	50	50	70	80	-	-	-
1000 V	-	-	40	40	40	50	70	80	-	-	-

Matrix C

The expanded uncertainties given in this table are expressed in µV/V.

SCOPE OF CALIBRATION: ELECTRICAL MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
AC Current AC current source	(See Matrix D)	(See Matrix D)	AC/DC comparison method using current shunts.
AC current indicating meter	(See Matrix E)	(See Matrix E)	AC current generation using Fluke 5720A with Fluke 5725A Amplifier (where applicable)

Frequency / Current	10 Hz	20 Hz	30 Hz	40 Hz	57 Hz	100 Hz	400 Hz	1 kHz	2 kHz	5 kHz	10 kHz
10 mA	50	50	50	50	50	50	50	50	50	50	50
25 mA	50	50	50	50	50	50	50	60	60	70	80
50 mA	60	60	60	60	60	60	60	60	60	60	60
100 mA	60	60	60	60	60	60	60	60	60	60	60
250 mA	60	60	60	60	60	60	60	60	60	60	60
1 A	100	100	100	100	100	100	100	100	100	100	100
2.5 A	90	90	90	90	90	90	90	90	90	90	90
5 A	360	360	360	360	360	360	425	425	425	425	-
10 A	320	320	320	320	320	320	320	320	320	400	-
20 A	410	410	410	410	410	410	410	410	410	410	-

Matrix D

The expanded uncertainties given in this table are expressed in μA/A.

SCOPE OF CALIBRATION: ELECTRICAL MEASUREMENTS

Frequency / Current	10 Hz	20 Hz	40 Hz	1 kHz	5 kHz	10 kHz
100 µA	420	270	210	210	410	1760
1 mA	300	200	160	160	320	760
10 mA	300	200	130	130	260	610
100 mA	300	200	150	150	240	1210
1 A	-	140	300	300	540	7170
10 A	-	-	480	480	990	3680

Matrix E

The expanded uncertainties given in this table are expressed in µA/A.

Signatories:

1. **Nazri Bin Marzuki**
2. **Dr. Muhammad Azwan Bin Ibrahim**
3. **Nor Azrin Bin Hassan**

SCOPE OF CALIBRATION: ELECTRICAL MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
AC POWER & ENERGY			
AC power single phase	120 V, 240 V 1 A to 50 A pf = 0.5 to 1 50 Hz	70 µW/W	Comparison method with power converter
AC power three phase	120 V, 240 V 1 A to 20 A pf = 0.5 to 1 50 Hz	240 µW/W	Comparison method with standard watt converter
AC energy single phase	120 V, 240 V 1 A to 50 A pf = 0.5 to 1 50 Hz	120 µWh/Wh	Comparison method with power converter
AC energy three phase	120 V, 240 V 1 A to 50 A pf = 0.5 to 1 50 Hz	220 µWh/Wh	Comparison method with three phase comparator

Signatory:

1. **Nazri Bin Marzuki**
2. **Syarizal Bin Zainal Abidin**

SCOPE OF CALIBRATION: ELECTRICAL MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
High Voltage/Current and Instrument Transformer			
AC high voltage ratio: real component	Primary: 3300 V to 11000 V Secondary: 110 V	0.05 %	Comparison method with standard voltage transformer at 50 Hz.
Phase angle error		0.8 ’	
AC high current ratio: real component	Primary: 5 A to 2000 A Secondary: 5 A	0.05 %	Comparison method with standard current transformer at 50 Hz.
Phase angle error		0.8 ’	

Signatories:

1. **Nazri Bin Marzuki**
2. **Syazwan Bin Muhamad Ayub**

SCOPE OF CALIBRATION: ELECTRICAL MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
AC/DC HIGH VOLTAGE			
AC high voltage divider/meter Scale factor	10 kV to 200 kV @ 50 Hz		Comparison method with standard high voltage capacitor divider
1) AC Peak/√2 voltages (negative and positive)		0.11 %	
2) AC RMS voltage		0.21 %	
DC high voltage divider/meter Scale factor	10 kV to 150 kV	0.10 %	Comparison method with standard high voltage resistive divider

Signatories:

1. **Nazri Bin Marzuki**
2. **Syazwan Bin Muhamad Ayub**

SCOPE OF CALIBRATION: ELECTRICAL MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
CAPACITANCE Capacitance : low loss capacitor, fixed values	1 pF: 1 kHz, 1.592 kHz 10 pF: 1 kHz, 1.592 kHz 100 pF: 1 kHz, 1.592 kHz 1000 pF: 1 kHz, 1.592 kHz	5 μF/F	Calibration using capacitance bridge, substitution method.
Capacitance : dielectric capacitor (e.g. mica or polystyrene)	1 to 10 μF: 1 kHz 10 to 100 μF: 1 kHz	0.5 mF/F 1 mF/F	Calibration using capacitance meter, substitution method.
Capacitance : Dissipation factor	5×10^{-6} to 1×10^{-4}: 1 kHz	3×10^{-6}	Calibration using capacitance bridge and Dissipation Factor standard, direct method.
Capacitance : Variable/decade capacitor	100 pF to 1 μF: 1 kHz	0.5 mF/F	Calibration using capacitance meter, substitution method.
Capacitance meters	1 pF to 1 μF: 1 kHz, 1.592 kHz	2 μF/F	Calibration by comparison method.

Signatories:

1. **Nazri Bin Marzuki**
2. **Ts. Dr. Dewi Salawati Binti Mohd Kassim**

SCOPE OF CALIBRATION: ELECTRICAL MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
INDUCTANCE			
Inductance standards	100 μH: 1 kHz 1 mH: 1 kHz 10 mH: 1 kHz 100 mH: 1 kHz 1 H: 1 kHz 10 H: 1 kHz	300 μH/H 200 μH/H	Calibration by comparison using ratio bridge.
Decade values	100 μH to 10 H: 1 kHz	0.6 mH/H	Calibration using Inductance meter, substitution method.
Inductance meters	100 μH: 1 kHz 1 mH to 10 H: 1 kHz	310 μH/H 210 μH/H	Calibration by comparison method.

Signatories:

1. **Nazri Bin Marzuki**
2. **Ts. Dr. Dewi Salawati Binti Mohd Kassim**

SCOPE OF CALIBRATION: ELECTRICAL MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
RF Power			
Power Sensor Thermistor Mount Type-N, 50 Ω	0.9 to 1 10 MHz to 12 GHz 12 GHz to 18 GHz	2.00% 2.40%	Direct comparative technique
Power Sensor Thermistor Mount APC7, 50 Ω	0.9 to 1 10 MHz to 12 GHz 12 GHz to 18 GHz	2.00% 2.40%	Direct comparative technique
Power Meter For Type-N, 50 Ω	1 mW 50 MHz	0.84%	Direct comparative technique
Scalar RF reflection coefficient and attenuation			
Step Attenuator Type-N, 50 Ω APC7, 50 Ω	10 dB to 40 dB (50 MHz to 2 GHz) (2 GHz to 18 GHz) 40 dB to 50 dB (50 MHz to 2 GHz) (2 GHz to 18 GHz) 50 dB to 60 dB (50 MHz to 2 GHz) (2 GHz to 18 GHz) 60 dB to 70 dB (50 MHz to 2 GHz) (2 GHz to 18 GHz)	0.05 dB 0.1 dB 0.1 dB 0.1 dB 0.2 dB 0.2 dB 0.5 dB 0.5 dB	Direct measurement technique
Scattering Parameter			
Magnitude of reflection coefficient on coaxial lines for Type-N, 50 Ω and APC7, 50 Ω	0 to 0.1 10 MHz to 18 GHz	0.015	Direct measurement technique

Signatories:

1. **Nazri Bin Marzuki**
2. **Dr. Arshad Bin Selamat**

SCOPE OF CALIBRATION: ELECTRICAL MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
DC Magnetic Flux Density Magnetometers	0.1 mT to 20 mT	Refer to Matrix A	Generation of DC magnetic field using Helmholtz coil.
	100 mT to 1.6 T	Refer to Matrix B	Generation of DC magnetic field using electromagnet.
Magnetic Flux Flux Indicator	0.1 mWb to 10 Wb	1 mWb/Wb	Calibrated using Fluxmeter Calibrator MTC-1. Search coil is not tested.

Matrix A

Range (mT)	Uncertainty (mT/T)
0.1 to 15	2.0
16 to 20	1.5

Matrix B

Range (mT)	Uncertainty (mT)
100 to 300	0.2
400 to 600	0.3
700 to 1200	0.6
1300 to 1600	1.6

Signatory:

1. **Ts.Dr. Shakirah Binti Mohd Amran**
2. **Mardiana Shahadatul Aini Binti Lalu Zainudin**

SCOPE OF CALIBRATION: ELECTRICAL MEASUREMENTS

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (±)*	Remarks **
Portable Gas Detector Methane, CH_4 Hydrogen Sulphide, H_2S Carbon Monoxide, CO Oxygen, O_2	 50 % LEL 25 ppm 100 ppm 18 %	 1.3 % 1.6 ppm 2.4 ppm 0.4 %	Calibration using reference gas .
Gas Analyzer Carbon Monoxide, CO Propane, C_3H_8	 4.5 % 2000 ppm	 0.9 % 40 ppm	Calibration using reference gas

Signatory:

1. **Ts. Hisam Bin Sumiry**

SCOPE OF CALIBRATION: TIME AND FREQUENCY MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
TIME & FREQUENCY			
Frequency Sources (With Time Base Output)	200 kHz to 225 MHz	2 parts in 10^{12}	Direct frequency measurement.
Frequency Sources (Without Time Base Output)	1 Hz to 225 MHz	3 mHz	Direct frequency measurement.
Time Interval Measurement (Stopwatch)	1 s to 100,000 s	1 ms	Direct comparison with reference time interval.
Time Interval Measurement (Timer)	0.01 s to 100,000 s	0.3 ms	Direct comparison with reference time interval.
Frequency	1 MHz 5 MHz 10 MHz	1 parts in 10^{12} 1 parts in 10^{12} 1 parts in 10^{12}	Phase Comparison
GPS-based Speed Meter	500 Hz (20 km h^{-1}) 2000 Hz (80 km h^{-1}) 3000 Hz (120 km h^{-1}) 4000 Hz (160 km h^{-1}) 7500 Hz (300 km h^{-1})	1.1 Hz (0.05 km h^{-1}) 1.1 Hz (0.05 km h^{-1}) 1.1 Hz (0.05 km h^{-1}) 1.1 Hz (0.05 km h^{-1}) 1.7 Hz (0.07 km h^{-1})	Direct frequency measurement

Signatories:

1. **Nazri Bin Marzuki**
2. **Ahmad Sahar Bin Omar**
3. **Mohd Rafiq Bin Abdul Kamal**

SCOPE OF CALIBRATION: VIBRATION MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
VOLTAGE SENSITIVITY Vibration Pick-up	20 Hz to 5 kHz	1.0 %	Comparison Calibration with Reference Standard Accelerometer
Reference Standard Accelerometer	10 Hz to 200 Hz 200 Hz to 250 Hz 250 Hz to 5 kHz 5 kHz to 8 kHz 8 kHz to 10 kHz	0.4 % 0.5 % 0.4 % 0.6 % 1.0 %	Primary Vibration Calibration by Laser Interferometry
Working Standard Accelerometer	10 Hz to 200 Hz 200 Hz to 250 Hz 250 Hz to 5 kHz 5 kHz to 8 kHz 8 kHz to 10 kHz	0.7 % 0.8 % 0.7 % 0.9 % 1.2 %	Comparison Calibration with Reference Standard Accelerometer
CHARGE SENSITIVITY Vibration Pick-up	20 Hz to 5 kHz	1.0 %	Comparison Calibration with Reference Standard Accelerometer
Reference Standard Accelerometer	10 Hz to 200 Hz 200 Hz to 250 Hz 250 Hz to 5 kHz 5 kHz to 8 kHz 8 kHz to 10 kHz	0.4 % 0.5 % 0.4 % 0.6 % 1.0 %	Absolute Calibration
Working Standard Accelerometer	10 Hz to 200 Hz 200 Hz to 250 Hz 250 Hz to 5 kHz 5 kHz to 8 kHz 8 kHz to 10 kHz	0.7 % 0.8 % 0.7 % 0.9 % 1.2 %	Comparison Calibration with Reference Standard Accelerometer

SCOPE OF CALIBRATION: VIBRATION MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
ACCELERATION Acceleration measuring chain	10 Hz to 5 kHz	1.0 % (160 Hz)	Comparison Calibration with Reference Standard Accelerometer
VELOCITY Velocity measuring chain	10 Hz to 5 kHz	1.1 % (160 Hz)	Comparison Calibration with Reference Standard Accelerometer
DISPLACEMENT Displacement measuring chain	10 Hz to 5 kHz	1.2 % (160 Hz)	Comparison Calibration with Reference Standard Accelerometer

Signatories:

1. **Ts. Shahrul Nizam Bin Abdul Rashid**
2. **Md. Aizuddin Bin Rosdan**

SCOPE OF CALIBRATION: **VIBRATION MEASUREMENTS**

SITE CALIBRATION: **CATEGORY I**

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
ACCELERATION Acceleration measuring chain	< 500 m/s^2 (20 Hz to 5 kHz)	2.0 %	Direct measurement using reference vibration meter
VELOCITY Velocity measuring chain	< 1000 mm/s (20 Hz to 2 kHz)	2.0 %	Direct measurement using reference vibration meter
DISPLACEMENT Displacement measuring chain	< 20 mm (20 Hz to 500 Hz)	2.0 %	Direct measurement using reference vibration meter

Signatories:

1. **Ts. Shahrul Nizam Bin Abdul Rashid**
2. **Md. Aizuddin Bin Rosdan**

SCOPE OF CALIBRATION: ACOUSTIC MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
SOUND PRESSURE LEVEL Pistonphone	114 dB to 124 dB	0.2 dB	Comparison with Reference Pistonphone
Sound Level Calibrator	94 dB to 114 dB	0.2 dB	Comparison with Reference Sound Calibrator
Sound Level Calibrator	94 dB to 124 dB	0.1 dB (31.5 Hz to 8 kHz) 0.12 dB (12.5 kHz to 16 kHz)	Comparison with Laboratory Standard Microphones
SOUND PRESSURE LEVEL Sound Level Meter (Frequency Weighting - Electrical Calibration	94 dB to 114 dB (31.5 Hz to 16 kHz)	0.1 dB	Electrical test using sine generator (manual calibration)
Sound Level Meter (Level Range Control - Electrical Calibration)	54 dB to 124 dB (31.5 Hz to 16 kHz)	0.1 dB	Electrical test using sine generator (manual calibration)
Sound Level Meter (Linearity - Electrical Calibration)	50 dB to 130 dB (31.5 Hz to 16 kHz)	0.1 dB	Electrical test using sine generator (manual calibration)
Sound Level Meter (Frequency Weighting - Acoustical Calibration)	94 dB to 114 dB (31.5 Hz to 16 kHz)	0.3 dB (31.5 Hz to 4 kHz) 0.4 dB (4 kHz to 8 kHz) 0.5 dB (8 kHz to 12.5 kHz)	Acoustic test signal generated by acoustic calibrator

SCOPE OF CALIBRATION: ACOUSTIC MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Sound Level Meter (Level Range Control - Acoustical Calibration)	64 dB to 124 dB (1 kHz)	0.5 dB	Acoustic test signal generated by acoustic comparator
Sound Level Meter (Linearity - Acoustical Calibration)	60 dB to 120 dB (1 kHz)	0.5 dB	Acoustic test signal generated by acoustic comparator
PRESSURE SENSITIVITY Measurement Microphone	250 Hz	0.1 dB	Comparison with Laboratory Standard Microphones
Laboratory Standard Microphones type LS1P	31.5 Hz 63 Hz 125 Hz to 4 kHz 5 kHz 6.3 kHz 8 kHz 10 kHz	0.07 dB 0.05 dB 0.04 dB 0.05 dB 0.06 dB 0.07 dB 0.10 dB	Primary method for pressure calibration of laboratory standard microphones by the reciprocity technique
Laboratory Standard Microphones type LS2P	31.5 Hz 63 Hz 125 Hz to 8 kHz 10 kHz 12.5 kHz 16 kHz	0.07 dB 0.05 dB 0.04 dB 0.05 dB 0.06 dB 0.07 dB	Primary method for pressure calibration of laboratory standard microphones by the reciprocity technique

Signatories:

1. **Ts. Shahrul Nizam Bin Abdul Rashid**
2. **Md. Aizuddin Bin Rosdan**
3. **Dr. Nurhalawa Binti Md Yusof**

SCOPE OF CALIBRATION: PHOTOMETRY AND RADIOMETRY MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Luminous Intensity Tungsten Lamp	100 cd to 1000 cd	0.9 %	Comparison with reference lamp/photometer
Luminous Flux Tungsten Lamp	300 lm to 4000 lm	1.3 %	Comparison with reference lamp
Illuminance Tungsten Lamp	1 lx to 3000 lx	0.9 %	Comparison with reference lamp/photometer
Correlated Colour Temperature Tungsten Lamp	2600 K to 3000 K	20 K	Comparison with reference lamp
Transmittance Spectrally Neutral Material	380 nm to 780 nm	0.0001 to 0.2 %	Calibrated using reference spectrophotometer
Responsivity Fibre Optic Power Meter	100 µW	2 %	Calibrated using reference optical power meter at 1310nm and 1550nm

Signatories:

1. **Ts. Dr. Mohd Nizam Bin Abdullah**
2. **Ts. Muhammad Zawawi Bin Samsuddin**

SCOPE OF CALIBRATION: TEMPERATURE MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
RESISTANCE TEMPERATURE DETECTOR Std. Platinum Resistance Thermometer (SPRT)	TP of Mercury (-38.8344 °C)	1.3 mK	Reference by fixed Point Cell in : alcohol bath, ice bath, oil bath and fixed point furnace
	TP of Water (0.01 °C)	0.8 mK	
	MP of Gallium (29.7646 °C)	2.0 mK	
	FP of Indium (156.5985 °C)	3.4 mK	
	FP of Tin (231.928 °C)	3.5 mK	
	FP of Zinc (419.527 °C)	4.3 mK	
	-38.8344 °C to 29.7646 °C	2.9 mK	Reference by fixed Point Cell in: alcohol bath, ice bath, oil bath and fixed point furnace
	0.01°C to 29.7646 °C	2.3 mK	
	0.01°C to 156.5985 °C	3.5 mK	
	0.01°C to 231.928 °C	3.6 mK	
	0.01°C to 419.527 °C	4.4 mK	
Std. Platinum Resistance Thermometer (SPRT)	-80 °C to 0 °C	0.02 °C	Comparison with Standard Resistance Thermometers in: alcohol bathwater bath oil bath calibration furnace
	0 °C to 90 °C	0.01 °C	
	90 °C to 250 °C	0.02 °C	
	250 °C to 420 °C	0.04 °C	
	420 °C to 970 °C	0.1 °C	
Industrial Platinum Resistance Thermometer (IPRT)	-80 °C to -50 °C	0.04 °C	Comparison with Standard Platinum Resistance Thermometers in: alcohol bath water bath oil bath calibration furnace
	-50 °C to 0 °C	0.04 °C	
	0 °C to 90 °C	0.03 °C	
	90 °C to 250 °C	0.04 °C	
	250 °C to 400 °C	0.08 °C	
	400 °C to 660 °C	0.1 °C	

SCOPE OF CALIBRATION: TEMPERATURE MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Temperature sensors with display unit	-80 °C to -50 °C -50 °C to 0 °C 0 °C to 90 °C 90 °C to 250 °C 250 °C to 400 °C 400 °C to 660 °C	0.04 °C 0.04 °C 0.03 °C 0.04 °C 0.08 °C 0.1 °C	Comparison with Standard Resistance Thermometers in: alcohol bath water bath oil bath calibration furnace
LIQUID-IN-GLASS THERMOMETER Total Immersion (Graduation:≥ 0.1 °C)	-80 °C to 0 °C 0 °C to 90 °C 90 °C to 300 °C	0.1 °C 0.04 °C 0.08 °C	Comparison with PT100 reference in: alcohol bath water bath oil bath
Partial Immersion (Graduation:≥ 0.1 °C)	-80 °C to 0 °C 0 °C to 90 °C 90 °C to 300 °C	0.2 °C 0.2 °C 0.2 °C	Comparison with PT100 reference in: alcohol bath water bath oil bath

Signatory:

1. **Nurulaini Binti Md Ali**
2. **Dr. Nafra Binti Mohamad Samiudin (except calibration by fixed point method)**

SCOPE OF CALIBRATION: TEMPERATURE MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
RADIATION THERMOMETER Radiation thermometers	-30 °C to 50 °C	0.4 °C	Comparison with standard Pt100 probe in liquid bath-based blackbody source
	50 °C to 100 °C 100 °C to 300 °C 300 °C to 400 °C 400 °C to 450 °C	1.0 °C 2.1 °C 2.9 °C 3.3 °C	Comparison with standard Pt100 probe in blackbody furnace

Signatory:

1. **Dr. Siti Zaleha Binti Mohd Nor**

SCOPE OF CALIBRATION: TEMPERATURE MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
THERMOCOUPLE			
Thermocouple (Type K, N, T)	0 °C to 660 °C	1.0 °C	Calibration of thermocouple by comparison in dry block against PT100
Thermocouple (Type R & S)	0 °C to 660 °C	0.9 °C	Calibration of thermocouple by comparison in dry block against PT100

Signatory:

1. **Nurulaini Binti Md Ali**

SCOPE OF CALIBRATION: TEMPERATURE MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Calibration of dry-well block calibrators	-50 °C to 0 °C 0 °C to 300 °C 300 °C to 600 °C	0.01 °C 0.05 °C 0.08 °C	Measurement with calibrated SPRT or Pt100 probe in dry block at specified points of calibration.

Signatory:

1. **Nurulaini Binti Md Ali**

SCOPE OF CALIBRATION: **TEMPERATURE MEASUREMENTS**

SITE CALIBRATION: **CATEGORY I**

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Calibration of Autoclave	100 °C to 200 °C	0.6 °C	Measurement with calibrated thermocouple or PT100 probe & multichannel datalogger
Calibration of Controlled Temperature Enclosure	-80 °C to 0 °C 0 °C to 90 °C 90 °C to 250 °C	0.5 °C 0.6 °C 1.5 °C	Measurement with calibrated thermocouple or PT100 probe & multichannel datalogger

Signatories:

1. **Nurulaini Binti Md Ali**

SCOPE OF CALIBRATION: HUMIDITY MEASUREMENTS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
TEMPERATURE AND HUMIDITY INDICATOR Relative humidity sensor	10 %rh to 95 %rh	y = 0.004x + 0.781 y : Expanded uncertainty (%rh) x : Measured value of unit under test (%rh)	Comparison with dew point hygrometer in humidity chamber
Air Temperature	5 °C to 65 °C	0.2 °C	Comparison with temperature standard in humidity chamber
Temperature Sensor (Air Temperature)	-70 °C to 5 °C 65 °C to 100 °C	0.2 °C 0.2 °C	Comparison with temperature standard in humidity chamber
Dew Point Meter	-20 °C to 40 °C	0.18 °C	Comparison with dew point hygrometer in humidity chamber
Dew Point Meter (High Dew Point)	40 °C to 65 °C	0.18 °C	Comparison with dew point hygrometer in humidity chamber

Signatories:

1. **Suhaila Binti Khairuddin**

SCOPE OF CALIBRATION: CHEMICAL

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (±)*	Remarks **
Ethanol Aqueous Solution	0.5 to 5.0 mg/g	3% of reading	Preparation by gravimetric Method, Confirmation using GC-FID

Signatories:

1. **Haslina Binti Abdul Kadir**
2. **Noor Hidaya Binti Abdul Nasir**

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (±)*	Remarks
Methane in Nitrogen	10 µmol/mol to 500 000 µmol/mol	0.53 %	CP-85-211 Preparation of Methane in Nitrogen Gas by Gravimetric System CP-085-207 Determination of Methane in Nitrogen Gas by Gas Chromatography Methanizer Flame Ionization Detector

Signatory:

1. **ChM. Dr Mohamad Fauzi Bin Ahmad**

SCOPE OF CALIBRATION: CHEMICAL

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (±)*	Remarks
Gold Content	750.0 to 999.9 mg/g 580.0 to 749.0 mg/g	1.5 mg/g 1.4 mg/g	ISO 23345:2021 Jewellery and precious metal- Non destructive precious metal fineness confirmation by ED-XRF

Signatory:

1. **Ts. Adlan Akram Bin Mohamad Mazuki**
2. **Abdullah Bin Othman**

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (±)*	Remarks
Gold and Articles of Gold Alloy	585.0 to 999.0 mg/g	0.75mg/g	Based on ISO 11426:2021 Jewellery and precious metals – Determination of gold – Cupellation method (fire assay)

Signatory:

1. **Ts. Dr. Mohd Fazrulhisyam Bin Mohd Nor**
2. **Noor Razinah Binti Rahmat**

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (±)*	Remarks
Silver content	800.0 to 999.0 mg/g	2.0 mg/g	ISO 23345: - Jewellery and precious metals – Non destructive precious metal fineness confirmation by ED-XRF

Signatory:

1. **Ts. Adlan Akram Bin Mohamad Mazuki**
2. **Abdullah Bin Othman**

Issue date: 16 May 2024
Valid until: 15 December 2028

No: SAMM 261

SCOPE OF CALIBRATION: CHEMICAL

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (±)*	Remarks **
Reference Material:pH Buffer	pH 4.01 to pH 6.86	0.03	Provide verification and calibration services for pH buffer using pH high accuracy system