SINGAPORE LABORATORY ACCREDITATION SCHEME

Accredited Laboratory SAC-SINGLAS

Schedule

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FIELD OF TESTING: Calibration and Measurement

MEASURED QUANTITIES / INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	CALIBRATION & MEASUREMENT CAPABILITY (CMC*)
A. DIMENSIONAL METROLOGY		
A1. Bevel Protractor (Lab)	BS 1685 : 2008	
i Straightness & Parallelism	Opus in-house procedure OPCP-01 Issue 04	0.0001 inch
ii Indication of Error		5 min
A2. Bore Gauge (Lab)	JIS B 7515 : 1982	2.0 µm
0 ~ 2 mm (Plunger Travel)	Opus in-house procedure OPCP-02 Issue 04	
A3. Vernier Caliper (Lab)	JIS B 7507 : 2016	10 µm
0 ~ 1000 mm	Opus in-house procedure OPCP-03 Issue 04	
A4. Caliper Checker (Lab)	Opus in-house procedure OPCP-04 Issue 04	
Up to 600 mm		1.3 µm
Parallelism		1.2 µm
A5. Dial Caliper Gauge / Dial Thickness Gauge (Lab)	Opus in-house procedure OPCP-05 Issue 04	
Up to 50 mm (Digital)		1.1 µm
Up to 50 mm (Analog)		2.2 µm
A6. Dial Gauge Tester (Lab)	Opus in-house procedure OPCP-06 Issue 04	
Up to 50.8 mm		0.3 µm
Up to 2 inch		0.00001 inch
A7. Dial Indicator (Lab)	JIS B 7503: 2017	
up to 10 mm	DIN 879-1: 1999	0.5 µm
above 10 mm to 20 mm	ASME B89.1.10M-2001	1.0 µm
above 20 mm to 50 mm	Opus in-house procedure OPCP-07 Issue 04	1.4 µm
above 50 mm to 80 mm		2.0 µm
above 80 mm to 100 mm		2.5 µm

MEASURED QUANTITIES / INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	CALIBRATION & MEASUREMENT CAPABILITY (CMC*)
A8. Dial Test Indicator (Lab)	JIS B 7533: 2015 ASME B89.1.10M-2001	
0 ~ 1 mm	Opus in-house procedure OPCP-08 Issue 04	0.6 µm
A9. Digimatic Indicator (Lab)	Opus in-house procedure OPCP-09 Issue 04	
Up to 30 mm		0.8 µm
Above 30 mm to 50 mm		1.4 µm
Above 50 mm to 80 mm		2.0 µm
Above 80 mm to 100 mm		2.5 µm
A10. Feeler Gauge (Lab)	BS 957: 2008	
0 ~ 1 mm	Opus in-house procedure OPCP-10 Issue 04	1.0 µm
A11. Granite Surface Plate (Lab / on-site) Up to 3000 mm	BS 817: 2008 Opus in-house procedure OPCP-12 Issue 04	
i Overall Flatness		3.0 µm
ii Variation from local flatness		1.0 µm
A12. Linear Height Gauge (Lab / on-site)	Opus in-house procedure OPCP-13 Issue 04	
0 to 600 mm		2.0 µm
600 to 900 mm		3.0 µm
A13. Vernier Height Gauge (Lab)	Opus in-house procedure OPCP-14 Issue 04	
up to 600 mm		10 µm
A14. Height Setting Micrometer (Lab)	ISO 7863: 1984(R2018)	
up to 300mm	Opus in-house procedure OPCP-15 Issue 04	1.3 µm
A15. Holtest (Lab)	DIN 863 Part 4: 1999 &	
3 mm to 63 mm	Opus in-house procedure OPCP-16	2.3 µm
63 mm to 100 mm	Issue 04	2.4 µm
100 mm to 200 mm		3.8 µm

MEASURED QUANTITIES / INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	CALIBRATION & MEASUREMENT CAPABILITY (CMC*)
A16. External Micrometer (Lab)	Opus in-house procedure OPCP-17	
Up to 100 mm	Issue 04	1.0 µm
Above 100 mm to 300 mm		2.0 µm
Above 300 mm to 500 mm		3.0 µm
Above 500 mm to 1000mm		4.0 µm
A17. Internal & Stick Micrometer (Lab)	BS 959: 2008	
i. Micrometer Head – up to 25mm	Opus in-house procedure OPCP-18 Issue 04	2.0 µm
ii. Extension Rod- Up to 300mm		4.0 µm
A18. Depth Micrometer (Lab)	BS 6468: 2008	
Up to 300mm	Opus in-house procedure OPCP-19 Issue 04	2.0 µm
A19. Pin Gauge / Plug Gauge (Lab)	BS 969: 2008, as a guide	
Up to 25 mm	Opus in-house procedure OPCP-20	0.5 µm
Up to 50 mm	Issue 04	1.0 µm
Up to 100 mm		1.2 µm
A20. Plain Ring Gauge (Lab)	BS 969: 2008, as a guide	
3 mm to 30 mm	Opus in-house procedure OPCP-21	0.8 µm
Above 30 mm to 100 mm	Issue 04	1.2 µm
Above 100mm to 150mm		2.6 um
A21. Profile Projector (Lab / on-site)	JIS B 7184: 1999	
Up to 300 mm	Opus in-house procedure OPCP-22 Issue 04	3.0 µm
A22. Setting Rod for External Micrometer (Lab)	Opus in-house procedure OPCP-24 Issue 04	
Up to 500 mm		1.2 µm
Above 500 mm to 1000 mm		2.0 µm
A23. Thread Plug Gauge (Lab) Up to 50 mm	ISO 1502: 1996 ANSI / ASME B1.2: 1983(R2017) BS 919 Pt 1 to Pt 4: 2007	
i Pitch & Major Diameter	BS 3643 Pt 1 & 2: 2007 BS 1580 Pt 1 & 3: 2007	1.0 µm
ii Pitch	Opus in-house procedure OPCP-26 Issue 04	3.0 µm
iii Flank Angle		3.0 min

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A24. Toolmaker Microscope (Lab / on-site) Up to 300 mm	JIS B 7153: 1995 Opus in-house procedure OPCP-27 Issue 04	3.0 µm
A25. Universal Length Measuring (Lab / on-site)	Opus in-house procedure OPCP-31 Issue 04	
0 to 10 mm		0.2 µm
(10 to 50) mm		0.3 µm
(50 to 80) mm		0.4 µm
(80 to 100) mm		0.5 µm
(100 to 500) mm		2.0 µm
(500 to 1000) mm		4.0 µm
A26. Vernier Depth Gauge (Lab)	BS 6365: 2008 Opus in-house procedure OPCP-32	
0 ~ 600mm	Issue04	10 µm
A27. Coating Thickness Foils (Plastic) (Lab)	Opus In–house procedure OPCP36 Issue 04	0.6 µm
A28. CMM (Coordinate Measuring Machine) (Lab)	ISO 10360-2 2009 AS GUIDE Opus in-house procedure OPCP-25 Issue 04	
(400x710x420) mm		4.8 µm
A29. Jig & Fixture Measurements (Lab) (400x710x420) mm	Opus in-house procedure OPCP-66 Issue 04	8 .0 µm
A30. Coating Thickness Gauge (Lab)	Opus in-house procedure OPCP-35 Issue 04	
0 ~ 2900 µm		0.7 µm

MEASURED QUANTITIES / INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	CALIBRATION & MEASUREMENT CAPABILITY (CMC*)
B. FORCE MEASUREMENT		
B1. Push / Pull Gauge (Lab)	Opus in-house procedure OPCP-23 Issue 04	
up to 500 gf		0.2 gf
above 0.5 kgf to 5 kgf		0.002 kgf
above 5 kgf to 10 kgf		0.01 kgf
above 10 kgf to 50 kgf		0.02 kgf
B2. Torque Gauge / Torque Meter (Lab)	Opus in-house procedure OPCP-28 Issue 04	
up to 1.5 kgf·cm		0.004 kgf·cm
up to 3.6 kgf·cm		0.01 kgf·cm
up to 9 kgf·cm		0.02 kgf·cm
up to 15 kgf·cm		0.1 kgf·cm
B3. Weighing Scale (Lab/ On-site)	Opus in-house procedure OPCP-30 Issue 04	
up to 310 g, Resolution: 0.0001g		0.0018 g
up to 620 g, Resolution: 0.001g		0.003 g
up to 5.2 kg, Resolution: 0.01g		0.05 g
up to 30 kg, Resolution: 1g		1.0 g
up to 100 kg, Resolution: 10g		10 g
up to 150 kg, Resolution: 20g		20 g
B4. Hand Torque Tool (Lab)	ISO 6789 -1& 2 : 2017	
Type I	Opus in-house procedure OPCP-29 Issue 04	
0.5 to 10 N.m		1.1 % reading
10 to 50 N.m		0.2 % reading
50 to 100 N.m		0.3 % reading
100 to 1000 N.m		0.4 % reading
1000 to 1500 N.m		0.3 % reading
Type II		
0.5 to 10 N.m		1.5 % reading
10 to 50 N.m		0.4 % reading
50 to 100 N.m		0.5 % reading
100 to 1000 N.m		0.7 % reading
1000 to 1500 N.m		0.3 % reading
B5. Velocity - Optical Tachometer Measuring (Non-Contact Tachometer)	Opus in-house procedure OPCP-059 Issue 04	**(Lab & Onsite)**
240 ~ 1000 RPM		2.0 RPM
1000 ~ 5000 RPM		2.0 RPM
5000 ~ 10000 RPM		2.0 RPM
10000 ~ 30000 RPM		2.0 RPM
30000 ~ 60000 RPM		3.0 RPM

MEASURED QUANTITIES / INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	CALIBRATION & MEASUREMENT CAPABILITY (CMC*)
C. Pressure Instruments (Lab & on-Site)		
C1. Pressure Measuring Devices Pneumatic Pressure Gauges Chart/Pen recorders Digital Indicators Manometers, Data loggers, Compound gauge Oil free & Oxygen Gauges Oil Pressure Gauges	Opus in-house procedure OPCP-033 Issue 04	
-13 psi to 30 psi		0.07 % of F.S
0 to 300 psi		0.03 % of F.S
0 to 1000 psi		0.03 % of F.S
0 to 3000 psi		0.03 % of F.S
0 to 10000 psi		0.03 % of F.S
C2. Pressure Switches (Pneumatic Service/ Oil free & Oxygen Service/ Hydraulic Oil)	Opus in-house procedure OPCP-034 Issue 04	
0 to 30 psi		0.07 % of F.S
0 to 300 psi		0.03 % of F.S
0 to 1000 psi		0.03 % of F.S
0 to 3000 psi		0.03 % of F.S
0 to 10000 psi		0.03 % of F.S
C3. Pressure Transmitter (Pneumatic Service/ Oil free & Oxygen Service/ Hydraulic Oil)	Opus in-house procedure OPCP-037 Issue 04	
0 to 30 psi		0.12 % of F.S
0 to 300 psi		0.12 % of F.S
0 to 1000 psi		0.12 % of F.S
0 to 3000 psi		0.12 % of F.S
0 to 10000 psi		0.12 % of F.S
C4. Pressure Transducer (Pneumatic Service/ Oil free & Oxygen Service/ Hydraulic Oil)	Opus in-house procedure OPCP-037 Issue 04	
0 to 30 psi		0.04 % of F.S
0 to 300 psi		0.03 % of F.S
0 to 1000 psi		0.03 % of F.S
0 to 3000 psi		0.03 % of F.S
0 to 10000 psi		0.03 % of F.S

MEASURED QUANTITIES / INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	CALIBRATION & MEASUREMENT CAPABILITY (CMC*)
D. Electrical (Lab & on-Site)		
D1. DC VOLTAGE MEASURING	Opus in-house procedure OPCP-053 Issue 04	
0 ~ 50 mV		0.006 mV
(50 ~ 100) mV		0.0077 mV
(100 ~ 150) mV		0.01 mV
(150 ~ 202) mV		0.012 mV
(0.20 ~ 0.25) V		0.000015 V
(0.25 ~ 0.50) V		0.000024 V
(0.50 ~ 1.00) V		0.000041 V
(1.00 ~ 2.02) V		0.00008 V
(2.00 ~ 10.00) V		0.00034 V
(10.00 ~ 20.20) V		0.0007 V
(20 ~ 100) V		0.004 V
(100 ~ 202) V		0.008 V
(200 ~ 500) V		0.023 V
(500 ~ 1000) V		0.04 V
D2. DC CURRENT MEASURING	Opus in-house procedure OPCP-049 Issue 04	
0 ~ 50 µA		0.041 µA
(50 ~ 100) µA		0.047 µA
(100 ~ 150) µA		0.053 µA
(150 ~ 202) µA		0.059 µA
(0.200 ~0.250) mA		0.00007 mA
(0.250 ~ 0.500) mA		0.000093 mA
(0.500 ~ 1.000) mA		0.00014 mA
(1.00 ~ 2.02) mA		0.00024 mA
(2.00 ~ 10.00) mA		0.00093 mA
(10.00 ~ 20.2) mA		0.0017 mA
(20 ~ 100) mA		0.013 mA
(100 ~ 202) mA		0.024 mA
(0.200 ~ 1.000) A		0.00022 A
(1.000 ~ 2.020) A		0.00041 A
(2 ~ 10) A		0.0051 A
(10 ~ 20) A		0.011 A
(20 ~ 30) A		0.1 A

MEASURED QUANTITIES / INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	CALIBRATION & MEASUREMENT CAPABILITY (CMC*)
D3. AC VOLTAGE MEASURING	Opus in-house procedure OPCP-045 Issue 04	
(20 ~ 50) mV	10 to 44 Hz 45 to 999 Hz 1 to 19.999 kHz 20 to 99.999 kHz	0.19 mV 0.063 mV 0.23 mV 2.6 mV
(50 ~ 100) mV	10 to 44 Hz 45 to 999 Hz 1 to 19.999 kHz 20 to 99.999 kHz	0.3 mV 0.082 mV 0.26 mV 2.6 mV
(100 ~ 150) mV	10 to 44 Hz 45 to 999 Hz 1 to 19.999 kHz 20 to 99.999 kHz	0.41 mV 0.11 mV 0.29 mV 2.6 mV
(150 ~ 202) mV	10 to 44 Hz 45 to 999 Hz 1 to 19.999 kHz 20 to 99.999 kHz	0.53 mV 0.13 mV 0.33 mV 2.7 mV
(0.200 ~ 0.250) V	10 to 44 Hz 45 to 999 Hz 1 to 19.999 kHz 20 to 99.999 kHz 100 to 500 kHz	0.00099 V 0.00046 V 0.0023 V 0.0038 V 0.026 V
(0.250 ~ 0.500) V	10 to 44 Hz 45 to 999 Hz 1 to 19.999 kHz 20 to 99.999 kHz 100 to 500 kHz	0.0016 V 0.00053 V 0.0023 V 0.0044 V 0.026 V
(0.500 ~ 1.000) V	10 to 44 Hz 45 to 999 Hz 1 to 19.999 kHz 20 to 99.999 kHz 100 to 500 kHz	0.0028 V 0.0007 V 0.0025 V 0.0057 V 0.027 V
(1.00 ~ 2.020) V	10 to 44 Hz 45 to 999 Hz 1 to 19.999 kHz 20 to 99.999 kHz 100 to 500 kHz	0.0052 V 0.0012 V 0.0032 V 0.0085 V 0.03 V
(2.00 ~ 10.00) V	40 to 44 Hz 45 to 999 Hz 1 to 19.999 kHz	0.027 V 0.0086 V 0.022 V

MEASURED QUANTITIES / INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	CALIBRATION & MEASUREMENT CAPABILITY (CMC*)
(10.0 ~ 20.2) V	40 to 44 Hz 45 to 999 Hz 1 to 19.999 kHz	0.051 V 0.012 V 0.027 V
(20.0 ~ 100) V	40 to 44 Hz 45 to 999 Hz	0.096 V 0.13 V
(100 ~ 202) V	40 to 44 Hz 45 to 999 Hz	0.2 V 0.16 V
(200 ~ 500) V	40 to 44 Hz 45 to 999 Hz	0.71 V 0.48 V
(500 ~ 1000) V	46 to 999 Hz 1 to 10 kHz	0.76 V 2.3 V
D4. AC CURRENT MEASURING	Opus in-house procedure OPCP-041 Issue 04	
(20 ~ 50) µA	40 to 44 Hz 45 to 999 Hz	0.49 µA 0.34 µA
(50 ~ 100) µA	40 to 44 Hz 45 to 999 Hz	0.59 µA 0.38 µA
(100 ~ 150) µA	40 to 44 Hz 45 to 999 Hz	0.69 µA 0.42 µA
(150 ~ 202) µA	40 to 44 Hz 45 to 999 Hz	0.8 µA 0.46 µA
(0.200 ~ 0.250) mA	40 to 44 Hz 45 to 999 Hz	0.0029 mA 0.00089 mA
(0.250 ~ 0.500) mA	40 to 44 Hz 45 to 999 Hz	0.0032 mA 0.0011 mA
(0.500 ~ 1.000) mA	40 to 44 Hz 45 to 999 Hz	0.0039 mA 0.0014 mA
(1.00 ~ 2.02) mA	40 to 44 Hz 45 to 999 Hz	0.0059 mA 0.002 mA

MEASURED QUANTITIES / INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	CALIBRATION & MEASUREMENT CAPABILITY (CMC*)
AC CURRENT MEASURING (Continue)	Opus in-house procedure OPCP-041 Issue 04	
(2 ~ 10) mA	40 to 44 Hz 45 to 999 Hz	0.029 mA 0.014 mA
(10 ~ 20.2) mA	40 to 44 Hz 45 to 999 Hz	0.059 mA 0.02 mA
(20 ~ 100) mA	40 to 44 Hz 45 to 999 Hz	0.39 mA 0.13 mA
(100 ~ 202) mA	40 to 44 Hz 45 to 999 Hz	0.59 mA 0.2 mA
(0.200 ~ 1.000) A	40 to 44 Hz 45 to 999 Hz	0.0039 A 0.0023 A
(1.000 ~ 2.02) A	40 to 44 Hz 45 to 999 Hz	0.0059 A 0.0031 A
(2.000 ~ 10) A	30 to 44 Hz 45 to 99 Hz 0.10 to 1 kHz	0.039 A 0.016 A 0.041 A
(10 ~ 20) A	30 to 44 Hz 45 to 99 Hz 0.10 to 1 kHz	0.053 A 0.025 A 0.075 A
(20 ~ 30) A	30 to 44 Hz 45 to 99 Hz 0.10 to 1 kHz	0.077 A 0.036 A 0.11 A

MEASURED QUANTITIES / INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	CALIBRATION & MEASUREMENT CAPABILITY (CMC*)
D5. RESISTANCE MEASURING (passive) - 2 wire	Opus in-house procedure OPCP-038 Issue 04	
185 mΩ		47 mΩ
280 mΩ		47 mΩ
1.2502 Ω		0.047 Ω
10.191 Ω		0.048 Ω
100.212 Ω		0.052 Ω
1.000229 kΩ		0.00014 kΩ
10.0005 kΩ		0.00097 kΩ
100.001 kΩ		0.0094 kΩ
0.999827 MΩ		0.00017 MΩ
9.99886 MΩ		0.0046 MΩ
99.943 MΩ		0.59 MΩ
993.54 MΩ		12 MΩ
D6. RESISTANCE MEASURING (passive) - 4 Wire	Opus in-house procedure OPCP-039 Issue 04	
0 mΩ		5.8 mΩ
100.00 mΩ		5.8 mΩ
1.00367 Ω		0.0059 Ω
10.0079 Ω		0.007 Ω
100.00365 Ω		0.012 Ω
1.000015 kΩ		0.000093 kΩ
10.000270 kΩ		0.00093 kΩ
100.0005 kΩ		0.0093 kΩ
D7. CAPACITANCE MEASURING	Opus in-house procedure OPCP-046 Issue 04	
1.0014 nF	1 kHz	0.027 nF
10.096 nF		0.06 nF
20.031 nF		0.2 nF
50.312 nF		0.3 nF
99.71 nF		0.4 nF
1.0001 µF		0.005 µF
10.227 µF		0.08 µF

MEASURED QUANTITIES / INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	CALIBRATION & MEASUREMENT CAPABILITY (CMC*)
D8. SIMULATED RESISTANCE MEASURING	Opus in-house procedure OPCP-038 Issue 04	
(10 ~ 100) Ω		0.093 Ω
(0.100 ~ 1.000) kΩ		0.00041 kΩ
(1 ~ 10) kΩ		0.0036 kΩ
(10 ~ 100) kΩ		0.035 kΩ
(0.10 ~ 1) MΩ		0.00035 MΩ
(1 ~ 10) MΩ		0.0036 MΩ
D9. FREQUENCY MEASURING	Opus in-house procedure OPCP-055 Issue 04	
(3 ~ 10) Hz		0.00024 Hz
10 Hz ~ 100 Hz		0.0024 Hz
100 Hz ~ 1000 Hz		0.024 Hz
1 kHz ~ 10 kHz		0.00024 kHz
10 kHz ~ 100 kHz		0.0024 kHz
100 kHz ~ 1000 kHz		0.024 kHz
D10. DC CURRENT CLAMP MEASURING	Opus in-house procedure OPCP-049 Issue 04	
(0.1 ~ 0.5) A		0.12 A
0.5 A ~ 1 A		0.12 A
(1 ~ 10) A		0.17 A
(10 ~ 50) A		0.4 A
(50 ~ 100) A		0.9 A
(100 ~ 500) A		4.0 A
(500 ~ 1000) A		6.0 A
(1000 ~ 1500) A		9.0 A
D11. AC CURRENT CLAMP MEASURING	Opus in-house procedure OPCP-041 Issue 04	
(0.1 ~ 0.5) A	(30Hz to 60 Hz)	0.11 A
(0.5 ~ 1) A		0.12 A
(1 ~ 10) A		0.17 A
(10 ~ 50) A		0.4 A
(50 ~ 100) A		0.9 A
(100 ~ 500) A		4.0 A
(500 ~ 1000) A		6.0 A
(1000 ~ 1500) A		9.0 A

MEASURED QUANTITIES / INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	CALIBRATION & MEASUREMENT CAPABILITY (CMC*)
D12. INSULATION RESISTANCE MEASURING	Opus in-house procedure OPCP-057 Issue 04	
(10 ~ 50) kΩ		0.12 kΩ
(50 ~ 100) kΩ		0.24 kΩ
(100 ~ 500) kΩ		1.2 kΩ
(0.50 ~1.00) MΩ		0.0024 MΩ
(1 ~ 5) MΩ		0.012 MΩ
(5 ~ 10) MΩ		0.35 MΩ
(10 ~ 50) MΩ		1.8 MΩ
(50 ~ 100) MΩ		3.5 MΩ
(100 ~ 500) MΩ		18 MΩ
(500 ~ 1000) MΩ		36 MΩ
(1000 ~ 2000) MΩ		70 MΩ
D13. INSULATION TEST VOLTAGE MEASURING	Opus in-house procedure OPCP-058 Issue 04	
0 ~ 50 V		0.32 V
50 V ~ 100 V		0.61 V
100 V ~ 250 V		1.5 V
250 V ~ 500 V		3 V
500 V ~ 1000 V		5.8 V
D14. CONTINUITY RESISTANCE MEASURING	Opus in-house procedure OPCP-047 Issue 04	
1 Ω		0.061 Ω
10 Ω		0.081 Ω
19 Ω		0.11 Ω
100 Ω		0.29 Ω
190 Ω		0.5 Ω
1000 Ω		2.4 Ω

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D15. DC VOLTAGE SOURCING	Opus in-house procedure OPCP-052 Issue 04	
0 ~ 100 mV		0.0085 mV
(0.100 ~ 1) V		0.000038 V
(1 ~ 10) V		0.00034 V
(10 ~ 100) V		0.0052 V
(100 ~ 500) V		0.036 V
(500 ~ 1000) V		0.06 V
D16. AC VOLTAGE SOURCING	Opus in-house procedure OPCP-044 Issue 04 (10 Hz to 20 kHz)	
(1 ~ 100) mV		0.17 mV
(0.100 ~ 1) V		0.0011 V
(1 ~ 10) V		0.011 V
(10 ~ 100) V		0.11 V
(100 ~ 500) V		0.64 V
(500 ~ 1000) V		1.1 V
D17. DC CURRENT SOURCING	Opus in-house procedure OPCP-048 Issue 04	
0 ~ 100 µA		0.088 µA
(0.100 ~ 1) mA		0.00064 mA
(1 ~ 10) mA		0.0082 mA
(10 ~ 100) mA		0.064 mA
(100 ~ 400) mA		0.26 mA
(0.400 ~ 1) A		0.00082 A
(1 ~ 3) A		0.0042 A
(3 ~ 10) A		0.02 A
D18. AC CURRENT SOURCING	Opus in-house procedure OPCP-040 Issue 04 (10 Hz to 1 kHz)	
(20 ~ 100) µA		0.25 µA
(0.100 ~ 1) mA		0.0017 mA
(1 ~ 10) mA		0.025 mA
(10 ~ 100) mA		0.17 mA
(100 ~ 400) mA		0.94 mA
(0.400 ~ 1) A		0.0017 A
(1 ~ 3) A		0.0088 A
(3 ~ 10) A		0.025 A

MEASURED QUANTITIES / INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	CALIBRATION & MEASUREMENT CAPABILITY (CMC*)
D19. RESISTANCE SOURCING	Opus in-house procedure OPCP-061 Issue 04	
(1 ~ 10) Ω		0.0047 Ω
(10 ~ 100) Ω		0.017 Ω
(0.100 ~ 1) kΩ		0.00013 kΩ
(1 ~ 10) kΩ		0.0013 kΩ
(10 ~ 100) kΩ		0.013 kΩ
(0.1 ~ 1) MΩ		0.00013 MΩ
(1 ~ 10) MΩ		0.0048 MΩ
D20. FREQUENCY SOURCING	Opus in-house procedure OPCP-054 Issue 04	
(3 ~ 1000 Hz		0.012 Hz
100 Hz ~ 1000 Hz		0.12 Hz
1 kHz ~ 10 kHz		0.0012 kHz
(10 ~ 100) kHz		0.012 kHz
100 kHz ~ 1000 kHz		0.12 kHz
D21. DC POWER MEASURING	Opus in-house procedure OPCP-051 Issue 04	
(0.3 ~ 10) W		0.011 W
(10 ~ 100) W		0.2 W
(100 ~ 500) W		0.99 W
(0.500 ~ 1.000) kW		0.0013 kW
1 kW ~ 12 kW		0.01 kW
D22. AC POWER MEASURING (Power Factor = 1)	Opus in-house procedure OPCP-043 Issue 04 (50 Hz & 400 Hz)	
(0.3 ~ 100 W		0.12 W
(10 ~ 100) W		0.6 W
(100 ~ 500) W		1.2 W
(0.500 ~ 1.000) kW		0.0018 kW
1 kW ~ 12 kW		0.014 kW
D23. DC HIGH VOLTAGE SOURCING	Opus in-house procedure OPCP-050 Issue 04	
0 ~ 1 kV		0.09 kV
(1 ~ 5) kV		0.15 kV
(5 ~ 10) kV		0.24 kV
(10 ~ 20) kV		0.7 kV
(20 ~ 30) kV		1.5 kV
(30 ~ 40) kV		1.6 kV

MEASURED QUANTITIES / INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	CALIBRATION & MEASUREMENT CAPABILITY (CMC*)
D24. AC HIGH VOLTAGE SOURCING (50 Hz)	Opus in-house procedure OPCP-042 Issue 04	
0.01 kV ~ 1 kV		0.12 kV
1 kV ~ 5 kV		0.32 kV
5 kV ~ 10 kV		0.73 kV
10 kV ~ 20 kV		1.5 kV
20 kV ~ 28 kV		1.9 kV
D25. Milli-Ohm meter / Continuity Tester	Opus in-house procedure OPCP-056 Issue 04	
10 mΩ		0.86 mΩ
22 mΩ		0.87 mΩ
30 mΩ		0.99 mΩ
51 mΩ		1.6 mΩ
100 mΩ		2.6 mΩ
500 mΩ		6.3 mΩ
1 Ω		0.071 Ω
2 Ω		0.079 Ω
5 Ω		0.096 Ω
10 Ω		0.13 Ω
20 Ω		0.26 Ω
50 Ω		0.58 Ω
100 Ω		1.2 Ω
200 Ω		3.3 Ω
500 Ω		5.8 Ω
1000 Ω		12 Ω
D26. High Voltage Insulation Resistance Measuring	Opus in-house procedure OPCP-056 Issue 04	
10 kΩ		0.47 kΩ
500 kΩ		5.8 kΩ
1 MΩ		0.012 MΩ
2 MΩ		0.024 MΩ
4 MΩ		0.047 MΩ
5 MΩ		0.068 MΩ
10 MΩ		0.12 MΩ
20 MΩ		0.24 MΩ
30 MΩ		0.36 MΩ
40 MΩ		0.5 MΩ
50 MΩ		0.59 MΩ
100 MΩ		1.4 MΩ
200 MΩ		3.8 MΩ

MEASURED QUANTITIES / INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	CALIBRATION & MEASUREMENT CAPABILITY (CMC*)	
500 MΩ		8.2 MΩ	
1000 MΩ		14 MΩ	
2000 MΩ		29 MΩ	
5000 MΩ		69 MΩ	
E. Temperature			
E1. (a) Temperature Indicator/controller, Digital Thermometer & Temperature Measuring Instruments (electrical simulation)	Opus in-house procedure OPCP-062 Issue 04		
		Lab	**Onsite**
Thermocouple Simulation -Type J			
-210 °C to -100 °C		0.38 °C	1.2 °C
-100 °C to -30 °C		0.30 °C	1.2 °C
-30 °C to 150 °C		0.29 °C	1.0 °C
150 °C to 760 °C		0.33 °C	1.0 °C
760 °C to 1200 °C		0.36 °C	1.1 °C
Thermocouple Simulation -Type K			
-200 °C to -100 °C		0.42 °C	1.2 °C
-100 °C to -25 °C		0.32 °C	1.2 °C
-25 °C to 120 °C		0.30 °C	0.96 °C
120 °C to 1000 °C		0.35 °C	0.96 °C
1000 °C to 1370 °C		0.40 °C	1.1 °C
Thermocouple Simulation -Type T			
-250 °C to -150 °C		0.76 °C	1.3 °C
-150 °C to 0 °C		0.29 °C	1.2 °C
0 °C to 120 °C		0.29 °C	0.89 °C
120 °C to 400 °C		0.3 °C	0.89 °C
Thermocouple Simulation -Type R			
-0 °C to 250 °C		0.97 °C	2.2 °C
250 °C to 1000 °C		0.60 °C	2.0 °C
1000 °C to 1760 °C		0.66 °C	2.0 °C
Thermocouple Simulation -Type S			
0 °C to 250 °C		0.97 °C	2.2 °C
250 °C to 1000 °C		0.58 °C	2.0 °C
1000 °C to 1760 °C		0.66 °C	2.0°C

MEASURED QUANTITIES / INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	CALIBRATION & MEASUREMENT CAPABILITY (CMC*)	
Thermocouple Simulation -Type N		**Lab**	**Onsite**
-200 °C to -100 °C		0.56°C	1.2 °C
-100 °C to -25 °C		0.36 °C	0.92 °C
-25 °C to 120 °C		0.33 °C	0.92 °C
120 °C to 410 °C		0.32 °C	0.92 °C
410 °C to 1300 °C		0.39 °C	0.92 °C
Thermocouple Simulation - Type E			
-250 °C to -100 °C		0.71 °C	1.6 °C
-100 °C to -25 °C		0.29°C	1.5 °C
-25 °C to 350 °C		0.29 °C	1.2 °C
350 °C to 650 °C		0.31 °C	1.2 °C
650 °C to 1000 °C		0.32 °C	1.2 °C
(b) Temperature Calibrator / Temperature Sourcing Instruments (Electrical Simulation)	Opus in-house procedure OPCP-062 Issue 04		
		Lab	**Onsite**
Thermocouple Measuring - Type J			
-210 °C to -100 °C		0.62 °C	0.93 °C
-100 °C to -30 °C		0.58 °C	0.93 °C
-30 °C to 150 °C		0.57 °C	0.75 °C
150 °C to 760 °C		0.59 °C	0.82 °C
760 °C to 1200 °C		0.60 °C	0.85 °C
Thermocouple Measuring - Type K			
-200 °C to -100 °C		0.56 °C	1.1 °C
-100 °C to -25 °C		0.49 °C	1.0 °C
-25 °C to 120 °C		0.48 °C	0.78 °C
120 °C to 1000 °C		0.51 °C	0.78 °C
1000 °C to 1370 °C		0.55 °C	1.0 °C
Thermocouple Measuring - Type T			
-250 °C to -150 °C		0.91 °C	1.1 °C
-150 °C to 0 °C		0.58 °C	1.1 °C
0 °C to 120 °C		0.58 °C	0.73 °C
120 °C to 400 °C		0.58 °C	0.73 °C

MEASURED QUANTITIES / INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	CALIBRATION & MEASUREMENT CAPABILITY (CMC*)	
Thermocouple Measuring - Type R			
		Lab	**Onsite**
-0 °C to 250 °C		1.1 °C	2.0 °C
250 °C to 1000 °C		0.8 °C	1.8 °C
1000 °C to 1760 °C		0.9 °C	1.9 °C
Thermocouple Measuring - Type S			
0 °C to 250 °C		1.3 °C	2.0 °C
250 °C to 1000 °C		1.0 °C	1.8 °C
1000 °C to 1760 °C		1.1 °C	1.9 °C
Thermocouple Measuring - Type N			
-200 °C to -100 °C		0.81 °C	1.4 °C
-100 °C to -25 °C		0.68 °C	1.4 °C
-25 °C to 120 °C		0.67 °C	0.96 °C
120 °C to 410 °C		0.67 °C	1.0 °C
410 °C to 1300 °C		0.70 °C	1.0 °C
Thermocouple Measuring - Type E			
-250 °C to -100 °C		0.87 °C	1.3 °C
-100 °C to -25 °C		0.58 °C	0.73 °C
-25 °C to 350 °C		0.57 °C	0.73 °C
350 °C to 650 °C		0.58 °C	0.73 °C
650 °C to 1000 °C		0.59 °C	0.73 °C

MEASURED QUANTITIES / INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	CALIBRATION & MEASUREMENT CAPABILITY (CMC*)	
E2. (a) RTD Indicator / Digital Thermometer	Opus in-house procedure OPCP-063 Issue 04		
(**PRT100- 4 wire)**		**Lab**	
-99.983 °C		0.06 °C	
0.021 °C		0.03 °C	
30.016 °C		0.04 °C	
60.020 °C		0.05 °C	
99.983 °C		0.06 °C	
199.96 °C		0.08 °C	
399.86 °C		0.09 °C	
799.36 °C		0.10 °C	
(2 wire)			
PRT100		**Lab**	**Onsite**
-200 °C to 0 °C		0.16 °C	0.24 °C
0 °C to 300 °C		0.64 °C	0.42 °C
300 °C to 800 °C		0.64 °C	0.61 °C
PRT25		**Lab**	
-200 °C to 0 °C		0.58 °C	
0 °C to 800 °C		0.70 °C	
PRT250		**Lab**	
-200 °C to 0 °C		0.29 °C	
0 °C to 800 °C		0.35 °C	
PRT500		**Lab**	
-200 °C to 0 °C		0.12 °C	
0 °C to 800 °C		1.1 °C	
PRT1000		**Lab**	
-200 °C to 0 °C		0.10 °C	
0 °C to 800 °C		0.52 °C	
(b) RTD Calibrator/Sourcing instruments (Simulation)	Opus in-house procedure OPCP-063 Issue 04		
(PRT100-4 wire)		**Lab**	**Onsite**
-200 °C to 0 °C		0.11 °C	0.27 °C
0 °C to 200 °C		0.16 °C	0.31 °C
200 °C to 600 °C		0.27 °C	0.42 °C
600 °C to 800 °C		0.27 °C	0.53 °C
(PRT100-2 wire)		**Lab**	**Onsite**
-200 °C to 0 °C		0.17 °C	0.26 °C
0 °C to 200 °C		0.18 °C	0.71 °C
200 °C to 600 °C		0.22 °C	0.77 °C
600 °C to 800 °C		0.23 °C	0.84 °C

MEASURED QUANTITIES / INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	CALIBRATION & MEASUREMENT CAPABILITY (CMC*)
E3. (a) Contact thermometer with/ without display (RTD Probe/ RTD probe c/w display)	Opus in-house procedure OPCP-064 Issue 04	
		Lab **Onsite**
-30 °C to 0 °C		0.16 °C 0.16 °C
0 °C to 125 °C		0.16 °C 0.16 °C
125 °C to 250 °C		0.25 °C 0.25 °C
250 °C to 400 °C		0.64 °C 0.64 °C
(b) Bimetal thermometer/ Temperature transmitter/ Recorder/ Switch		
		Lab **Onsite**
-30 °C to 0 °C		0.18 °C 0.18 °C
0 °C to 125 °C		0.25 °C 0.25 °C
125 °C to 250 °C		0.38 °C 0.38 °C
250 °C to 400 °C		0.70 °C 0.70 °C
E4. (a) Thermocouple with/ without display	Opus in-house procedure OPCP-065 Issue 04	
		Lab
-30 °C to 0 °C		0.31 °C
0 °C to 125 °C		0.34 °C
125 °C to 250 °C		0.40 °C
250 °C to 400 °C		0.78 °C
Thermocouple with display	Opus in-house procedure OPCP-065 Issue 04	
		Onsite
-30 °C to 0 °C		0.22 °C
0 °C to 125 °C		0.30 °C
125 °C to 250 °C		0.35 °C
250 °C to 400 °C		0.73 °C
Thermocouple without display	Opus in-house procedure OPCP-065 Issue 04	
		Onsite
K Type		
-30 °C to 0 °C		0.95 °C
0 °C to 250 °C		0.57 °C
250 °C to 400 °C		0.86 °C
		Onsite
J Type		
-30 °C to 0 °C		0.72 °C
0 °C to 250 °C		0.57 °C
250 °C to 400 °C		0.86 °C

	MEASURED QUANTITIES / INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	CALIBRATION & MEASUREMENT CAPABILITY (CMC*)
	T Type -30 °C to 0 °C 0 °C to 250 °C 250 °C to 400 °C		**Onsite** 0.95 °C 0.57 °C 0.86 °C
	R/ S Type -30 °C to 0 °C 0 °C to 250 °C 250 °C to 400 °C		**Onsite** 1.6 °C 1.7 °C 1.8 °C
	N Type -30 °C to 0 °C 0 °C to 250 °C 250 °C to 400 °C		**Onsite** 1.2 °C 0.77 °C 1.0 °C
	E Type -30 °C to 0 °C 0 °C to 250 °C 250 °C to 400 °C		**Onsite** 0.51 °C 0.57 °C 0.86 °C
	(b) Thermocouple extension wire (Thermocouple simulation wire) K TYPE 0 °C to 50 °C J TYPE 0 °C to 50 °C T TYPE 0 °C to 50 °C R TYPE 0 °C to 50 °C S TYPE 0 °C to 50 °C N TYPE 0 °C to 50 °C E TYPE 0 °C to 50 °C	Opus in-house procedure OPCP-065 Issue 04	**Lab** 6.4 µV 7.3 µV 6.5 µV 4.8 µV 4.8 µV 5.6 µV 8.2 µV
E5.	Dry block calibrator/ Liquid bath -30 °C to 125 °C 125 °C to 250 °C 250 °C to 500 °C	Opus in-house procedure OPCP-067 Issue 04	**Lab** **Onsite** 0.15 °C 0.15 °C 0.20 °C 0.20 °C 0.61 °C 0.61 °C
E6.	Temperature& Humidity Measurement (Thermohygrometer/Barometer/ Humidity transmitter/Recorder/ Thermohygrograph) 10 °C to 50 °C 30 %r.h to 90% r.h.	Opus in-house procedure OPCP-068 Issue 04	**Lab** 0.5 °C 3.0 % relative humidity

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MEASURED QUANTITIES / INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	CALIBRATION & MEASUREMENT CAPABILITY (CMC*)
E7. (a) Surface Probe with/without display	Opus in-house procedure OPCP-069 Issue 04	**Lab** / **Onsite**
Up to 50 °C		3.0 °C / 3.0 °C
50 °C to 150 °C		3.4 °C / 3.4 °C
150 °C to 200 °C		4.4 °C / 4.4 °C
200 °C to 350 °C		4.7 °C / 4.7 °C
(b) Hot Plate	Opus in-house procedure OPCP-069 Issue 04	**Lab** / **Onsite**
Up to 50 °C		3.0 °C / 3.0 °C
50 °C to 150 °C		3.2 °C / 3.2 °C
150 °C to 350 °C		4.4 °C / 4.4 °C
E8. (a) Temperature enclosures (Oven/Freezer/Incubator/Furnace)	Opus in-house procedure OPCP-070 Issue 04	**Lab** / **Onsite**
-80 °C to 100 °C		1.7 °C / 1.7 °C
100 °C to 200 °C		2.1 °C / 2.1 °C
200 °C to 400 °C		2.9 °C / 2.9 °C
400 °C to 600 °C		3.3 °C / 3.3 °C
600 °C to 800 °C		4.1 °C / 4.1 °C
800 °C to 1000 °C		5.1 °C / 5.1 °C
1000 °C to 1100 °C		5.6 °C / 5.6 °C
(b) Temperature & Humidity enclosures (Chamber)	Opus in-house procedure OPCP-070 Issue 04	**(Lab & Onsite)** Temperature / Humidity
10 ~ 25 °C / up to 20 %r.h.		0.9 °C 3.1 %r.h.
10 ~ 25 °C / 20 ~ 50 %r.h.		0.9 °C 4.2 %r.h.
10 ~ 25 °C / 50 ~ 90 %r.h.		0.9 °C 6.3 %r.h.
25 ~ 50 °C / up to 20 %r.h.		1.0 °C 3.1 %r.h.
25 ~ 50 °C / 20 ~ 50 %r.h.		1.0 °C 4.1 %r.h.
25 ~ 50 °C / 50 ~ 90 %r.h.		1.0 °C 5.4 %r.h.
(c) System Accuracy test (Temperature)	Opus in-house procedure OPCP-070 Issue 04	**Lab** / **Onsite**
-80 °C to 200 °C		1.5 °C / 1.5 °C
200 °C to 400 °C		2.3 °C / 2.3 °C
400 °C to 800 °C		3.5 °C / 3.5 °C
800 °C to 1000 °C		4.9 °C / 4.9 °C
1000 °C to 1100 °C		5.5 °C / 5.5 °C
System Accuracy test (Temperature/Humidity) (10 ~ 50) °C / (20 ~ 90) %r.h.		**(Lab & Onsite)** Temperature / Humidity 0.5 °C 3.0 %r.h.

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MEASURED QUANTITIES / INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	CALIBRATION & MEASUREMENT CAPABILITY (CMC*)
E9. Non-contact thermometer Emissivity (ε=0.95) Up to 50 °C 50 °C to 100 °C 100 °C to 200 °C 200 °C to 300 °C 300 °C to 400 °C 400 °C to 500 °C	Opus in-house procedure OPCP-071 Issue 04	 **Lab** 0.9 °C 1.1 °C 2.3 °C 2.9 °C 3.6 °C 5.3 °C

* CMC is expressed as an expanded uncertainty estimated at a level of confidence of approximately 95%.

Approved Signatories

Mr Peter Foo - For all items except E2

Mr R Senthil - For Categories B, C, D, E

Note :

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025. A laboratory's fulfilment 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 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.