



# CERTIFICATE OF ACCREDITATION

*This is to attest that*

## **HONG KONG AIRCRAFT ENGINEERING CO. LTD. – CALIBRATION AND METROLOGY CENTRE**

80 CHUN CHOI STREET, TSEUNG KWAN O INDUSTRIAL ESTATE, TSEUNG KWAN O  
NEW TERRORIES, HONG KONG SAR

### **Calibration Laboratory CL-210**

has met the requirements of AC204, *IAS Accreditation Criteria for Calibration Laboratories*, and has demonstrated compliance with ISO/IEC Standard 17025:2017, *General requirements for the competence of testing and calibration laboratories*. This organization is accredited to provide the services specified in the scope of accreditation.

Effective Date March 12, 2023

Expiration Date January 1, 2025



A handwritten signature in black ink that reads "Raj Nathan".

**President**

Visit [www.iasonline.org](http://www.iasonline.org) for current accreditation information.

# SCOPE OF ACCREDITATION

International Accreditation Service, Inc.

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## HONG KONG AIRCRAFT ENGINEERING CO. LTD. – CALIBRATION AND METROLOGY CENTRE

www.haeco.com

**Contact Name** Mr. Ng Wing Sau

**Contact Phone** + 852-22604015

*Accredited to ISO/IEC 17025:2017*

*Effective Date March 12, 2023*

### CALIBRATION AND MEASUREMENT CAPABILITY (CMC)\*

MEASURED QUANTITY or DEVICE TYPE CALIBRATED	RANGE	UNCERTAINTY <sup>1,2</sup> (±)	CALIBRATION METHOD OR PROCEDURE, STANDARD EQUIPMENT (OPTIONAL)
<i>Dimensional</i>			
External Micrometer	0.001 in to 8 in 8 in to 54 in	120 µin 510 µin	Imperial Gauge Block: Grade 0; Metric Gauge Block: Grade K; Metric Long Gauge Block: Grade K; Imperial Length Bar: Inspection Grade  (ACPM M109: Calibration of External Micrometer)
	0.01 mm to 225 mm	3 µm	
Inside Micrometer	1 in to 4 in 4 in to 57 in	80 µin 480 µin	Imperial Gauge Block: Grade 0; Metric Gauge Block: Grade K; Metric Long Gauge Block: Grade K; Imperial Length Bar: Inspection Grade; Metric inside Micrometer Checker: Mitutoyo 575-581  (ACPM M111: Calibration of Inside Micrometer)
	25 mm to 100 mm 100 mm to 1500 mm	2 µm 12 µm	
Caliper	0.001 in to 12 in 12 in to 80 in	800 µin 2400 µin	Imperial Gauge Block: Grade 0; Metric Gauge Block: Grade K;

\* If information in this CMC is presented in non-SI units, the conversion factors stated in NIST Special Publication 811 "Guide for the Use of the International System of Units (SI)" apply.

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Caliper (continued)	0.01 mm to 300 mm 300 mm to 2000 mm	0.02 mm 0.06 mm	Metric Long Gauge Block: Grade K; Imperial Length Bar: Inspection Grade; External Micrometer: Mitutoyo 293-340  (ACPM M110: Calibration of Caliper)
Depth Gauge	0.001 in to 4 in 4 in to 19 in	80 µin 160 µin	Imperial Gauge Block: Grade 0; Metric Gauge Block: Grade K; Metric Long Gauge Block: Grade K; Toolmakers Flat: OPUS 200mm diameter  (ACPM M104: Calibration of Depth Gauge)
	0.01 mm to 100 mm 100 mm to 500 mm	2 µm 4 µm	
Mitutoyo External Micrometer	0.001 in to 2 in 2 in to 4 in 4 in to 6 in 6 in to 13 in 13 in to 25 in 25 in to 37 in 37 in to 49 in 49 in to 54 in	15 µin 24 µin 30 µin 120 µin 270 µin 360 µin 490 µin 540 µin	Imperial Gauge Block Metric Gauge Block Metric Long Gauge Block Imperial Length Bar  (ASME B89.1.13)  (ACPM M121: Calibration of Mitutoyo External Micrometer)
	0.01 mm to 25 mm 25 mm to 225 mm	0.84 µm 2.4 µm	
Mitutoyo Inside Micrometer	1 in to 4 in 4 in to 20 in 20 in to 40 in 40 in to 57 in	17 µin 44 µin 170 µin 380 µin	Imperial Gauge Block; Metric Gauge Block; Metric Long Gauge Block; Imperial Length Bar; Metric inside Micrometer Checker  (ASME B89.1.13)  (ACPM M124: Calibration of Mitutoyo Inside Micrometer)
	25 mm to 100 mm 100 mm to 500 mm 500 mm to 1000 mm 1000 mm to 1500 mm	0.54 µm 0.80 µm 1.1 µm 1.5 µm	
Mitutoyo Depth Micrometer	0.001 in to 4 in 4 in to 10 in 10 in to 19 in	64 µin 98 µin 160 µin	Imperial Gauge Block; Metric Gauge Block; Metric Long Gauge Block; Tool marker Flat  (ASME B89.1.13)
	0.01 mm to 100 mm 100 mm to 500 mm	1.4 µm 3.8 µm	

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Mitutoyo Depth Micrometer (continued)			(ACPM M125: Calibration of Mitutoyo Depth Micrometer)
Mitutoyo Caliper	0.001 in to 4 in 4 in to 8 in 8 in to 24 in 24 in to 48 in 48 in to 80 in	33 µin 77 µin 240 µin 470 µin 760 µin	Imperial Gauge Block; Metric Gauge Block; Metric Long Gauge Block; Imperial Length Bar; External Micrometer (ASME B89.1.14)
	0.01 mm to 100 mm 100 mm to 200 mm 200 mm to 600 mm 600 mm to 1000 mm 1000 mm to 2000 mm	1.0 µm 1.9 µm 5.8 µm 9.4 µm 20 µm	(ACPM M120: Calibration of Mitutoyo Caliper)
Holtest	0.089 in, 0.1 in, 0.128 in, 0.16 in, 0.197 in, 0.24 in, 0.275 in, 0.35 in, 0.425 in, 0.5 in, 0.65 in, 0.7 in, 0.8 in, 1 in, 1.2 in, 1.4 in, 1.6 in, 1.8 in, 2 in, 2.4 in, 2.5 in, 2.8 in, 3 in, 3.5 in, 3.6 in, 4 in	80 µin	Imperial Setting Ring: Mitutoyo series 177 Inch Type  (ACPM M101: Calibration of Holtest)
	2 mm, 2.25 mm, 3 mm, 3.25 mm, 4 mm, 5 mm, 6 mm, 7 mm, 8 mm, 10 mm, 12 mm, 16 mm, 20 mm, 25 mm, 30 mm, 35 mm, 40 mm, 45 mm, 50 mm, 60 mm, 70 mm, 80 mm, 90 mm, 100mm	2 µm	Metric Setting Ring: Mitutoyo series 177 Metric Type  (ACPM M101: Calibration of Holtest)
Surface Table	4 in x 4 in to 100 in x100 in	28 µin	Talyvel 4;
	100 mm x 100 mm to 2540 mm x 2540 mm	0.71 µm	IR Thermometer: Fluke 59 Mini  (ACPM M106: Calibration of Surface Table)
Dial Gauge	0.0005 in to 6 in	250 µin	0 in to 1 in Dial Gage Calibrator: Mitutoyo 170-101-10  (ACPM M105: Calibration of Dial Gauge)
	0.01 mm to 150 mm	6 µm	0 mm to 25mm Dial Gage Calibrator: Mitutoyo 170-102-10  (ACPM M105: Calibration of Dial Gauge)
Protractor /Angle	10°, 15°, 30°, 45°, 53°, 90°	0.061°	Inspection Block Level:

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Protractor /Angle (continued)			Fowler 53-422-006-2; Sine Table; 90 Degree Angle: Starrett Grade AA  (ACPM M103: Calibration of Protractor /Angle)
	0° to 90°	0.11°	Digital Protractor: Mitutoyo 950-318  (ACPM M103: Calibration of Protractor /Angle)
	0° to 360°	0.30°	Protractor: Kover KQ-100  (ACPM M103: Calibration of Protractor /Angle)
Tape Ruler	0.1 in to 197 in 197 in to 314 in	0.026 in 0.061 in	Steel Tape: Stanley 8m/26 ft.  (ACPM M128: Calibration of Tape Ruler)
	1 mm to 5000 mm 5000 mm to 8000 mm	570 µm 1300 µm	
2D Measurement (Dimension / Diameter)	0.001 in to 1 in 1 in to 6 in 6 in to 12 in	57 µin 510 µin 770 µin	External Micrometer (ASME): Mitutoyo 293-340 Starrett 436 series  (ACPM M123: Calibration of 2D Dimensional Measurement)
	0.01 mm to 25 mm 25 mm to 225 mm	1.1 µm 10 µm	
	0.001 in to 8 in 8 in to 12 in 0.01 mm to 300 mm	1100 µin 1800 µin 23 µm	Caliper (ASME): Mitutoyo 500-322 Mitutoyo 500-173  (ACPM M123: Calibration of 2D Dimensional Measurement)
	0.0001 in to 1 in 1 in to 8 in 8 in to 12 in 0.01 mm to 10 mm 10 mm to 200 mm 200 mm to 300 mm	230 µin 360 µin 560 µin 4.6 µm 8.8 µm 15 µm	Profile Projector: Baty R400  (ACPM M123: Calibration of 2D Dimensional Measurement)
	Angle 0.1° to 180°	0.12°	
	0.0001 in to 12 in	830 µin	Depth Micrometer:

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2D Measurement (Dimension / Diameter) (continued)	0.0025 mm to 300 mm	21 µm	Mitutoyo 329-351-10  (ACPM M123: Calibration of 2D Dimensional Measurement)
	0.001 in to 6 in	510 µin	Inside Micrometer: Starrett 823  (ACPM M123: Calibration of 2D Dimensional Measurement)
	0.005 in to 12 in 0.125 mm to 300 mm	0.019 in 310 µm	Steel Rule: Shinwa 1016  (ACPM M123 Calibration of 2D Dimensional Measurement)
	0.0005 in to 24 in 0.01 mm to 500 mm	1600 µin 41 µm	Height Gauge: Mitutoyo HDM-14"AX  (ACPM M123: Calibration of 2D Dimensional Measurement)
	0.001 in to 9 in 0.01 mm to 100 mm	280 µin 2.8 µm	Gauge Block: Grade 0, Grade K; Length Bar: Inspection Grade  (ACPM M123: Calibration of 2D Dimensional Measurement)
	0.0015 in to 0.04 in 0.04 mm to 1 mm	780 µin 0.016 mm	Feeler Gauge: Proto 00mm25; Proto 000AA  (ACPM M123: Calibration of 2D Dimensional Measurement)
	0.028 in to 0.073 in	98 µin	Pin or Go/No Go Gauge: Meyer Class Z  (ACPM M123: Calibration of 2D Dimensional Measurement)
	0.1 in to 197 in 1 mm to 5000 mm	0.064 in 0.20 mm	Steel Tape: Stanley 8m/26 ft.



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2D Measurement (Dimension / Diameter) (continued)			(ACPM M123: Calibration of 2D Dimensional Measurement)
	0.004 in to 1 in 0.1 mm to 25 mm	31 µin 0.80 µm	Laser Scan Micrometer: Mitutoyo 544-499-1A  (ACPM M123: Calibration of 2D Dimensional Measurement)
Optical Comparator	0.0001 in to 12 in 0.002 mm to 300 mm	100 µin 2.0 µm	Glass Scale: Gage Line Technology Inc. model 12"/300mm  (ACPM M127: Calibration of Optical Comparator)
	Angle 0° to 360°	0.0054°	
Height Gauge	0.001 in to 12 in 12 in to 24 in 24 in to 36 in 36 in to 48 in	0.00053 in 0.0011 in 0.0023 in 0.0030 in	Imperial Gauge Block: Grade 0; Metric Gauge Block: Grade K; Metric Long Gauge Block: Grade K; Imperial Length Bar: Inspection Grade; Surface Table: Crown Grade A77  (ACPM M117: Calibration of Height Gauge)
	0.01 mm to 300 mm 300 mm to 500 mm 500 mm to 1000 mm	0.014 mm 0.032 mm 0.060 mm	
Steel Ruler	0.001 in to 49 in	0.018 in	Imperial Gauge Block: Grade 0; Metric Gauge Block: Grade K; Metric Long Gauge Block: Grade K; Imperial Length Bar: Inspection Grade; Surface plate: Starrett Grade AA; Surface table: Crown Grade A77; Straight edge: Mahr 0 DIN 874  (ACPM M119: Calibration of Steel Ruler)
	0.01 mm to 1250 mm	0.28 mm	
Coating thickness gauge (eddy current & ultrasonic)	0.001 in to 3 in 3 in to 4 in	57 µin 94 µin	Imperial Gauge Block: Grade 0;

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Coating thickness gauge (eddy current & ultrasonic) (continued)	0.01 mm to 25 mm 25 mm to 50 mm 50 mm to 100 mm	0.57 µm 0.82 µm 3.4 µm	Metric Gauge Block: Grade K  (ACPM M134: Calibration of Coating thickness gauge)
Optical Micrometer	0.0005 in to 1 in	60 µin	Imperial Gauge Block: Grade 0  (ACPM M132: Calibration of Optical Micrometer)
Laser Micrometer	0.005 in to 0.6 in 0.6 in to 1 in	10 µin 19 µin	Pin Gauge: Grade XX  (ACPM M129: Calibration of Laser Micrometer)
Igniter Depth Gauge	0.001 in to 7 in	0.00057 in	Imperial Gauge Block: Grade 0  (ACPM M133: Calibration of Igniter Depth Gauge)
Hardness Tester	Rockwell HRBW 21.68 to 55.22 HRBW 55.22 to 96.36  HRC 23.64 to 50.69 HRC 50.69 to 65.08  Rockwell Superficial 15-N (DIAMOND) 71.35 HR15N to 83.29 HR15N 83.29 HR15N to 91.75 HR15N  30-N (DIAMOND) 47.95 HR30N  HR15TW (TUNSTANG CARBIDE BALL) 75.84 HR15TW to 91.45 HR15TW	2.5 HRBW 1.1 HRBW  1.1 HRC 0.58 HRC  1.1 HR15N  0.84 HR15N  1.0 HR30N  1.1 HR15TW	Reference block  Rockwell Test Block: ASTM E18-20  (ACPM M131: Calibration of Hardness Tester)
<b>Mechanical</b>			
Electronic Balance	0.01 g to 210 g 210 g to 2 kg 2 kg to 6 kg 6 kg to 10 kg 10 kg to 15 kg	0.4 mg 4 mg 10 mg 16 mg 24 mg	E1 class weights (from 1 mg to 5 kg); F1 class weights: (from 10 mg to 160 kg) As per OIML R 111-1:2004



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Electronic Balance (continued)	15 kg to 30 kg 30 kg to 60 kg 60 kg to 150 kg	60 mg 4 g 8 g	(ACPM M113: Calibration of Electronic Balance)
Mass	0.01 g to 50 g 50 g to 100 g 100 g to 200 g 200 g to 1.2 kg 1.2 kg to 4 kg 4 kg to 12 kg	0.1 mg 0.4 mg 0.4 mg 3 mg 30 mg 300 mg	F1 class weights (from 10 mg to 160 kg) As per OIML R 111-1:2004  (ACPM M112: Calibration of Mass)
	12 kg to 60 kg	12 g	Electronic balance: BJC60k  (ACPM M112: Calibration of Mass)
Pressure (Pneumatic)	0.001 psi to 1 psi 1 psi to 7 psi 7 psi to 9 psi 9 psi to 300 psi 300 psi to 1000 psi	0.0003 psi 0.0013 psi 0.009 psi 0.1 % 0.4 psi	Digital Pressure Device: ZM200LS-DN0028; ZM200LS-DN0200; Module30psi; Module100psi; Module300psi; Module1kpsi  (ACPM M107: Calibration of Pressure)
Pressure (Hydraulic)	0.01 psi to 100 psi 100 psi to 500 psi 500 psi to 1000 psi 1000 psi to 5000 psi 5000 psi to 10000 psi 10000 psi to 15000 psi	0.04 psi 0.15 psi 0.4 psi 1.5 psi 4 psi 5 psi	Digital Pressure Device: ADT68102GP100PSIN; ADT68102GP500PSIN; ADT68102GP1KPSIN; ADT68102GP5KPSIN; ADT68102GP500PSIN; 15KPSIXP2IS2  (ACPM M107: Calibration of Pressure)
Pressure (Vacuum)	0.001 psi to -14.5 psi	0.005 psi	Digital Pressure Device: 15PSIXP2IS2  (ACPM M107: Calibration of Pressure)
Pressure (Absolute pressure)	0.2 psia to 14.5 psia 14.5 psia to 314.5 psia 314.5 psia to 1014.5 psia	0.017 psia 0.1 % 0.2 %	Barometer & Pressure module: Baro (Modulebaro); Module30psi; Module100psi; Module300psi; Module1kpsi

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Pressure (Absolute pressure)			(ACPM M107: Calibration of Pressure)
Flow – Gas	0.5 L/min to 1 L/min 1 L/min to 5 L/min	0.02 L/min 1.6 %	Precision Gas Flowmeter: P/N: MWB5SLPMD  (ACPM M116: Calibration of Flowmeter)
Flow – Water	0.3 gal/min to 0.9 gal/min 0.9 gal/min to 3 gal/min 3 gal/min to 9 gal/min 9 gal/min to 30 gal/min	0.02 gal/min 1.8 % 0.2 gal/min 1.8 %	Precision Turbine Flowmeter: P/N: SR30T/C; SR5T/C  (ACPM M116: Calibration of Flowmeter)
Flow – Oil	9 gal/min to 20 gal/min 20 gal/min to 90 gal/min	2.6 % 1.6 %	Precision Turbine Flowmeter: P/N: FT20AEU2LEAHR  (ACPM M116: Calibration of Flowmeter)
Volumetric Ware	0.1 mL to 5 mL 5 mL to 10 mL 10 mL to 100 mL 100 mL to 250 mL 250 mL to 500 mL 500 mL to 1000 mL 1000 mL to 2000 mL	0.04 mL 0.08 mL 0.40 mL 0.80 mL 2.00 mL 4.00 mL 8.00 mL	Electronic Balance & PRT: 5616-12  (ACPM M122: Calibration of Volumetric Ware)
Force – Tension	0.5 g to 3 g 3 g to 6 g 6 g to 10 g 10 g to 200 g 200 g to 500 g 500 g to 2000 g 2000 g to 3000 g	0.03 g 0.06 g 0.08 g 0.15 g 0.36 g 1.5 g 2.2 g	F1 class weight set as per OIML R 111-1:2004  (ACPM M130: Calibration of Force (by F1 class weight set))
	0.1 lbf to 200 lbf 200 lbf to 400 lbf	0.1 lbf 0.3 lbf	Dead Weight: HAEC176; AS11868  (ACPM M115: Calibration of Force (by Deadweight))  Digital Load Cell: P/N: 3169  (ACPM M114: Calibration of Force (by Loadcell))
	400 lbf to 5000 lbf	2.5 lbf	Digital Load Cell: P/N: 3210BFG-5K-B

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Force – Tension (continued)			(ACPM M114: Calibration of Force (by Loadcell))
	5000 lbf to 25000 lbf	13 lbf	Digital Load Cell: P/N: 1120AJ25K  (ACPM M114: Calibration of Force (by Loadcell))
Force -Compression	0.5 g to 3 g	0.03 g	F1 class weight set as per OIML R 111-1:2004  (ACPM M130: Calibration of Force (by F1 class weight set))
	3 g to 6 g	0.06 g	
	6 g to 10 g	0.08 g	
	10 g to 200 g	0.15 g	
	200 g to 500 g	0.36 g	
	500 g to 2000 g	1.5 g	
2000 g to 3000 g	2.2 g		
	0.1 lbf to 200 lbf	0.1 lbf	Dead Weight: HAEC176; AS11868  (ACPM M115: Calibration of Force (by Deadweight))  Digital Load Cell: P/N 3169  (ACPM M114: Calibration of Force (by Loadcell))
	200 lbf to 400 lbf	0.3 lbf	
	400 lbf to 5000 lbf	2.5 lbf	
	5000 lbf to 25000 lbf	13 lbf	
	6000 lbf to 60000 lbf 1360 kgf to 30000 kgf	0.08 % 4 kgf	
Torque	2.5 ozf·in to 2000 lbf·ft 5 lbf·in to 50 lbf·in (power tool)	0.5 % 1 %	System 8, Digital Torque tester  (ACPM M108: Calibration of Torque)

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Torque Meter	1.3 lbf·in to 100 lbf·in 100 lbf·in to 600 lbf·in  50 lbf·ft to 1500 lbf·ft	0.0057 lbf·in 0.058 lbf·in  0.06 %	Torque Wheel: P/N: D1SC; Torque Arm: P/N: TTCA-48A; Dead Weights  (ACPM M126: Calibration of Torque Meter)
<b>Thermal</b>			
Oven/ Bath/ Chamber/Freezer	-30 °C to 250 °C 250 °C to 1200 °C	0.6 °C 1 °C	Eurotherm 6100 Data Logger with type N sensor 30 channel  (ACPM E102: Calibration of Temperature-Controlled Enclosures of Temperature Chamber)
Thermometer (with sensor)	1 °C to 250 °C	0.32 °C	Oil / Water Bath with PRT Temperature Calibrator with Thermocouple: Oil Bath: DRAGO 934; Water Bath: NESLAB EX-300; PRT: FLUKE 5616  (ACPM E103: Calibration of Thermometer (with Sensor))
	250 °C to 1200 °C	1 °C	Furnace: PEGASUS 1200 PRT: FLUKE 5616  (ACPM E103: Calibration of Thermometer (with Sensor))
Infrared Thermometer	30 °C to 500 °C	1 °C	Fluke 9132 IR Calibrator  (ACPM E105: Calibration of Infrared Thermometer)
Thermohygrometer	20 %RH to 80 %RH (10 °C to 50 °C)	0.83 %RH 0.36 °C	Digital Thermohygrometer P/N: TESTO 645; Chamber  (ACPM E104: Calibration of Thermohygrometer)

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Temperature Simulation Thermocouple			
Type - E	-250 °C to 1000 °C	0.29 °C	Time Electronics 1017; Fluke 5700A Multifunction Calibrator; Tegam 845 Temperature Calibrator; Resistance box & Keysight 3458A Digital Multimeter  (ACPM E101: Calibration of Temperature Indicator)
Type - J	-200 °C to 1200 °C	0.29 °C	
Type - K	-200 °C to 1370 °C	0.29 °C	
Type - N	-200 °C to 1300 °C	0.29 °C	
Type - R	-50 °C to 1700 °C	0.29 °C	
Type - S	-50 °C to 1700 °C	0.29 °C	
Type - T	-250 °C to 400 °C	0.29 °C	
Type - B	1 °C to 1800 °C	0.29 °C	
Resistance Type	-200 °C to 850 °C	0.25 °C	
<b>Electrical – DC/LF</b>			
DC Voltage Generate <sup>3,5</sup>	10 mV to 20 mV 20 mV to 30 mV 30 mV to 50 mV 50 mV to 100 mV 100 mV to 220 mV 0.22 V to 1.0 V 1.0 V to 22 V 22 V to 220 V 220 V to 1000 V	360 µV/V 180 µV/V 120 µV/V 74 µV/V 40 µV/V 23 µV/V 11 µV/V 16 µV/V 14 µV/V	Fluke 5700A Multifunction Calibrator  (ACPM E107: Calibration of DC Voltage Measurement)
AC Voltage Generate <sup>3,5</sup>	2.2 mV to 10 mV (40 Hz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz) (100 kHz to 300 kHz)  10 mV to 22 mV (40 Hz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz) (100 kHz to 300 kHz) (300 kHz to 1 MHz)  22 mV to 220 mV (40 Hz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz) (100 kHz to 300 kHz) (300 kHz to 1 MHz)  0.22 V to 2.2 V (40 Hz to 20 kHz) (20 kHz to 50 kHz)	0.33 % 0.31 % 0.52 % 0.92 %  0.082 % 0.068 % 0.11 % 0.32 % 0.75 %  0.037 % 0.093 % 0.26 % 0.28 % 0.93 %  0.010 % 0.026 %	Fluke 5700A Multifunction Calibrator  (ACPM E109: Calibration of AC Voltage Measurement)

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AC Voltage Generate <sup>3,5</sup> (continued)	0.22 V to 2.2 V (50 kHz to 100 kHz) (100 kHz to 300 kHz) (300 kHz to 1 MHz)	0.073 % 0.14 % 0.79 %	Fluke 5700A Multifunction Calibrator  (ACPM E109: Calibration of AC Voltage Measurement)
	2.2 V to 22 V (40 Hz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz) (100 kHz to 300 kHz) (300 kHz to 1 MHz)	0.009 % 0.011 % 0.053 % 0.089 % 0.81 %	
	22 V to 219.9 V (40 Hz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz) (100 kHz to 300 kHz)	0.019 % 0.021 % 0.053 % 0.75 %	
	220 V to 1000 V (50 Hz to 1 kHz)	0.012 %	
DC Voltage Measure <sup>4,5</sup>	0.01 mV to 1 mV 1 mV to 50 mV 50 mV to 100 mV 100 mV to 1 V 1 V to 100 V 100 V to 1000 V	0.36 µV 45 µV/V 17 µV/V 13 µV/V 13 µV/V 12 µV/V	Keysight 3458A Digital Multimeter  (ACPM E106: Calibration of DC Voltage)
	500 V to 6 kV	1.2 V	
AC Voltage Measure <sup>4,5</sup> (Bandwidth < 2 MHz)	0.01 mV to 10 mV (1 Hz to 40 Hz) (40 Hz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz) (100 kHz to 300 kHz)	3.5 µV 1.3 µV 1.4 µV 2.5 µV 12 µV	Keysight 3458A Digital Multimeter  (ACPM E108: Calibration of AC Voltage)
	10 mV to 100 mV (1 Hz to 40 Hz) (40 Hz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz) (100 kHz to 300 kHz) (300 kHz to 1 MHz)	0.046 % 0.035 % 0.053 % 0.11 % 0.44 % 1.2 %	



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AC Voltage Measure <sup>4,5</sup> (Bandwidth < 2 MHz) (continued)	100 mV to 1 V (1 Hz to 40 Hz)	0.046 %	Keysight 3458A Digital Multimeter  (ACPM E108: Calibration of AC Voltage)
	(40 Hz to 20 kHz)	0.035 %	
	(20 kHz to 50 kHz)	0.053 %	
	100 mV to 1 V (50 kHz to 100 kHz)	0.11 %	
	(100 kHz to 300 kHz)	0.44 %	
	(300 kHz to 1 MHz)	1.2 %	
	1 V to 10 V (1 Hz to 40 Hz)	0.013 %	
	(40 Hz to 20 kHz)	0.019 %	
	(20 kHz to 50 kHz)	0.037 %	
	(50 kHz to 100 kHz)	0.093 %	
(100 kHz to 300 kHz)	0.35 %		
(300 kHz to 1 MHz)	1.1 %		
10 V to 100 V (1 Hz to 40 Hz)	(40 Hz to 20 kHz)	0.061 %	Datron 1081 Digital Multimeter  (ACPM E108: Calibration of AC Voltage)
	(40 Hz to 20 kHz)	0.042 %	
	(20 kHz to 50 kHz)	0.059 %	
	(50 kHz to 100 kHz)	0.16 %	
	(100 kHz to 300 kHz)	0.55 %	
	(300 kHz to 1 MHz)	1.8 %	
100 V to 700 V (50 Hz to 1 kHz)	0.052 %	Fluke 80K-6 High Voltage Probe with Fluke 8050A Digital Multimeter  (ACPM E108: Calibration of AC Voltage)	
700 V to 1000 V (50 Hz to 1 kHz)	0.046 %		
500 V to 6000 V (50 Hz)	7.5 V		
DC Current Generate <sup>3,5</sup>	10 µA to 20 µA	0.12 %	Fluke 5700A Multifunction Calibrator  (ACPM E111: Calibration of DC Current Measurement)
	20 µA to 30 µA	0.064 %	
	30 µA to 50 µA	0.045 %	
	50 µA to 220 µA	0.030 %	
	0.22 mA to 2.2 mA	0.012 %	
	2.2 mA to 22 mA	0.0079 %	
	22 mA to 220 mA	0.013 %	
	0.22 A to 1 A	0.037 %	

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DC Current Generate <sup>3,5</sup> (continued)	1 A to 2.2 A	0.016 %	
	2.2 A to 20 A	0.12 %	Time Electronics 5025 Multi-Function Calibrator  (ACPM E111: Calibration of DC Current Measurement)
	20 A to 1000 A	0.6 %	Time Electronics 5025 with 50 Turn Coil  (ACPM E111: Calibration of DC Current Measurement)
AC Current Generate <sup>3,5</sup>	10 µA to 220 µA (10 Hz to 20 Hz)	0.091 %	Fluke 5700A Multifunction Calibrator  (ACPM E113: Calibration of AC Current Measurement)
	(20 Hz to 40 Hz)	0.048 %	
	(40 Hz to 1 kHz)	0.019 %	
	10 µA to 220 µA (1 kHz to 5 kHz)	0.080 %	
	(5 kHz to 10 kHz)	0.20 %	
	0.22 mA to 2.2 mA (10 Hz to 20 Hz)	0.091 %	
	(20 Hz to 40 Hz)	0.048 %	
	(40 Hz to 1 kHz)	0.019 %	
	(1 kHz to 5 kHz)	0.080 %	
	(5 kHz to 10 kHz)	0.20 %	
	2.2 mA to 22 mA (10 Hz to 20 Hz)	0.091 %	
	(20 Hz to 40 Hz)	0.048 %	
(40 Hz to 1 kHz)	0.019 %		
(1 kHz to 5 kHz)	0.080 %		
(5 kHz to 10 kHz)	0.20 %		
22 mA to 220 mA (10 Hz to 20 Hz)	0.091 %		
(20 Hz to 40 Hz)	0.048 %		
(40 Hz to 1 kHz)	0.019 %		
(1 kHz to 5 kHz)	0.080 %		
(5 kHz to 10 kHz)	0.20 %		
0.22 A to 2.2 A (10 Hz to 1 kHz)	0.09 %		
(1 kHz to 5 kHz)	0.11 %		
(5 kHz to 10 kHz)	1.2 %		

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AC Current Generate <sup>3,5</sup> (continued)	2.2 A to 20 A (20 Hz to 500 Hz)	0.34 %	Time Electronics 5025 Multi-Function Calibrator  (ACPM E113: Calibration of AC Current Measurement)
	20 A to 1000 A (50 Hz)	0.6 %	Time Electronics 5025 Multi-Function Calibrator with 50 Turn Coil  (ACPM E113: Calibration of AC Current Measurement)
DC Current Measure <sup>4</sup>	0.01 µA to 10 µA 10 µA to 1 mA 1 mA to 100 mA 100 mA to 1 A	0.049 % 0.0068 % 0.0051 % 0.017 %	Keysight 3458A Digital Multimeter  (ACPM E110: Calibration of DC Current)
	1 A to 20 A 20 A to 50 A 50 A to 250 A	0.13 % 0.13 % 0.2 %	Keysight 3458A Digital Multimeter; Current shunts: OHM-LABS CS-20; OHM-LABS CS-50  (ACPM E110: Calibration of DC Current)
	100 A to 10 kA	3 %	Gould-Bass DTM25A Amperage Meter with Current Shunt  (ACPM E110: Calibration of DC Current)
AC Current Measure <sup>4,5</sup>	100 µA to 1 mA (10 Hz to 45 Hz) (45 Hz to 1 kHz)	0.49 % 0.10 %	Keysight 3458A Digital Multimeter  (ACPM E112: Calibration of AC Current)
	1 mA to 1 A (10 Hz to 20 Hz) (20 Hz to 45 Hz) (45 Hz to 10 kHz)	0.48 % 0.20 % 0.09 %	
	1 A to 20 A (40 Hz to 5 kHz)	0.7 %	Keysight 3458A Digital Multimeter; Current shunts: OHM-LABS CS-20; OHM-LABS CS-50;
	20 A to 50 A (40 Hz to 5 kHz)	0.7 %	(ACPM E112: Calibration of AC Current)

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AC Current Measure <sup>4,5</sup> (continued)	100 A to 10 kA (50 Hz)	3 %	Gould-Bass DTM25A Amperage Meter with Current Shunt  (ACPM E112: Calibration of AC Current)
DC Resistance Generate <sup>3,5</sup>	0.001 $\Omega$ 0.01 $\Omega$ 0.1 $\Omega$ 1 $\Omega$ 10 k $\Omega$	57 n $\Omega$ 0.57 $\mu\Omega$ 5.7 $\mu\Omega$ 57 $\mu\Omega$ 4.6 m $\Omega$	Standard resistors  (ACPM E115: Calibration of DC Resistance Measurement)
	1 $\Omega$ 1.9 $\Omega$ 10 $\Omega$ 19 $\Omega$ 100 $\Omega$ 190 $\Omega$ 1 k $\Omega$ 1.9 k $\Omega$ 10 k $\Omega$ 19 k $\Omega$ 100 k $\Omega$ 190 k $\Omega$ 1 M $\Omega$ 1.9 M $\Omega$ 10 M $\Omega$ 19 M $\Omega$ 100 M $\Omega$	130 $\mu\Omega/\Omega$ 130 $\mu\Omega/\Omega$ 38 $\mu\Omega/\Omega$ 36 $\mu\Omega/\Omega$ 23 $\mu\Omega/\Omega$ 23 $\mu\Omega/\Omega$ 17 $\mu\Omega/\Omega$ 17 $\mu\Omega/\Omega$ 16 $\mu\Omega/\Omega$ 16 $\mu\Omega/\Omega$ 19 $\mu\Omega/\Omega$ 19 $\mu\Omega/\Omega$ 31 $\mu\Omega/\Omega$ 28 $\mu\Omega/\Omega$ 53 $\mu\Omega/\Omega$ 63 $\mu\Omega/\Omega$ 150 $\mu\Omega/\Omega$	Fluke 5700 A Multifunction Calibrator  (ACPM E115: Calibration of DC Resistance Measurement)
	100 M $\Omega$ to 100 G $\Omega$	0.19 %	Megadek Megohm Decade Resistor  (ACPM E115: Calibration of DC Resistance Measurement)
DC Resistance Measure <sup>4,5</sup>	0.001 $\Omega$ to 1 $\Omega$ 1 $\Omega$ to 10 $\Omega$ 10 $\Omega$ to 100 $\Omega$ 0.1 k $\Omega$ to 100 k $\Omega$ 0.1 M $\Omega$ to 1.0 M $\Omega$ 1.0 M $\Omega$ to 10 M $\Omega$ 10 M $\Omega$ to 100 M $\Omega$ 100 M $\Omega$ to 1000 M $\Omega$	75 $\mu\Omega/\Omega$ 47 $\mu\Omega/\Omega$ 44 $\mu\Omega/\Omega$ 15 $\mu\Omega/\Omega$ 29 $\mu\Omega/\Omega$ 120 $\mu\Omega/\Omega$ 0.63 m $\Omega/\Omega$ 5.7 m $\Omega/\Omega$	Keysight 3458A Digital Multimeter  (ACPM E114: Calibration of DC Resistance)
	100 M $\Omega$ to 100 G $\Omega$	3 %	Megger MIT481/2 Insulation and Continuity Tester  (ACPM E114: Calibration of DC Resistance)

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Power Generate <sup>3,5</sup> (DC to 1 kHz)	0.1 W to 600 W 600 W to 1200 W 1200 W to 3000 W 3000 W to 6000 W	3.5 W 7 W 17 W 35 W	Time Electronics 5025 Multifunction Calibrator  (ACPM E117: Calibration of DC & AC Power Measurement)
Power Measure <sup>4,5</sup> (DC to 1 kHz)	DC: 5 W to 23100 W AC: 5 W to 23100 W	0.12 % 0.35 %	Yokogawa 2041 Single Phase Wattmeter  (ACPM E116: Calibration of DC & AC Power)
Capacitance Generate <sup>3,5</sup>	1000 pF	0.0082 pF	ESI 1000 Standard Capacitors  (ACPM E128: Calibration of Capacitance Measurement)
	100 pF to 1 µF	0.058 %	GR1423A Decade Capacitor  (ACPM E128: Calibration of Capacitance Measurement)
	1 nF to 100 nF 1 µF to 10 µF 10 µF to 100 µF	0.57 % 0.57 % 0.57 %	Time Electronics 5025 Multifunction Calibrator  (ACPM E128: Calibration of Capacitance Measurement)
Capacitance Measure <sup>4,5</sup>	1 pF to 1000 pF (1 kHz)	0.0038 %	Andeen Hagerling 2500A  (ACPM E127: Calibration of AC Capacitance)
	1000 pF to 100 µF (1 kHz)	0.38 %	LCR Meter 11025  (ACPM E127: Calibration of AC Capacitance)
Inductance Generate <sup>3,5</sup>	1 mH (400 Hz) (1 kHz) (10 kHz)	0.12 % 0.13 % 0.15 %	Standard Inductors  (ACPM E130: Calibration of Inductance Measurement)
	10 mH (400 Hz) (1 kHz) (10 kHz)	0.048 % 0.039 % 0.20 %	
	100 mH (400 Hz) (1 kHz) (10 kHz)	0.089 % 0.063 % 2.6 %	

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Inductance Generate <sup>3,5</sup> (continued)	1 H (400 Hz) (1 kHz)	0.020 % 0.38 %	Standard Inductors  (ACPM E130: Calibration of Inductance Measurement)
	Test Frequency (1 kHz) 1 mH 1.9 mH 5 mH 10 mH 19 mH 50 mH 100 mH 190 mH 500 mH 1 H 10 H	0.39 % 0.20 % 0.17 % 0.20 % 0.27 % 0.31 % 0.31 % 0.31 % 0.30 % 0.29 % 0.14 %	Time Electronics 5025 Multifunction Calibrator  (ACPM E130: Calibration of Inductance Measurement)  Time Electronics 5025 Multifunction Calibrator  (ACPM E130: Calibration of Inductance Measurement)
Inductance Measure <sup>4,5</sup>	1 mH to 10 H	0.35 %	Chroma 11025 LCR Meter  (ACPM E129: Calibration of Inductance)
<b>Time and Frequency</b>			
Frequency Generate <sup>3,5</sup>	0.01 Hz to 500 kHz	23 µHz/Hz	Agilent 33220A Function Generator  (ACPM E120: Calibration of Frequency Measurement)
	500 kHz to 2 GHz	3.5 µHz/Hz	Agilent 8648B Signal Generator  (ACPM E120: Calibration of Frequency Measurement)
Frequency Measure <sup>4,5</sup>	1 Hz to 4.5 GHz	0.62 nHz/Hz	Fluke PM6681R Frequency Reference / Counter  (ACPM E119: Calibration of Frequency)
Tachometer	5 rpm to 50 rpm 50 rpm to 500 rpm 500 rpm to 5000 rpm 5000 rpm to 100000 rpm	0.005 rpm 0.05 rpm 0.5 rpm 5 rpm	Agilent 33220A Function Generator; Monarch TACH-4A  (ACPM E124: Calibration of Tachometer)
Stopwatch and Timer	1 s to 86400 s	32 ms	Agilent 53131A Frequency Counter; Agilent 33220A Function Generator



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Stopwatch and Timer (continued)			(ACPM E123: Calibration of Stopwatch and Timer)
<b>RF/Microwave and Electromagnetics</b>			
RF Power Measure <sup>4,5</sup>	3.2 μW to 100 μW (100 kHz to 1 GHz)	4.5 %	HP8508A Vector Voltmeter  (ACPM E118: Calibration of RF Power)
	3.2 μW to 100 μW (50 MHz to 2 GHz)	3.2 %	Agilent E4417A RF Power Meter with E9325A Power Sensors  (ACPM E118: Calibration of RF Power)
VSWR Measurement	(300 kHz to 1 GHz) 1.0 VSWR to 1.5 VSWR 1.5 VSWR to 2.0 VSWR	0.019 VSWR 0.041 VSWR	HP8714 RF Network Analyzer  (ACPM E132: Calibration of VSWR)
	(1 GHz to 2 GHz) 1.0 VSWR to 1.5 VSWR 1.5 VSWR to 2.0 VSWR	0.026 VSWR 0.049 VSWR	
	(2 GHz to 3 GHz) 1.0 VSWR to 1.5 VSWR 1.5 VSWR to 2.0 VSWR	0.030 VSWR 0.053 VSWR	
Attenuation Measurement	(300 kHz to 2 GHz) 0 dB to 60 dB 60 dB to 80 dB	0.13 dB 0.22 dB	HP8714 RF Network Analyzer  (ACPM E131: Calibration of Attenuation)
	(2 GHz to 3 GHz) 0 dB to 60 dB 60 dB to 80 dB	0.14 dB 0.24 dB	
<b>Chemical/Gas</b>			
pH Meter	pH 4, pH 7, pH 10	0.03 pH	ISO 17034 certified reference pH Buffer calibration standard  (ACPM M135: Calibration of pH Meter)

<sup>1</sup>The uncertainty covered by the Calibration and Measurement Capability (CMC) is expressed as the expanded uncertainty having a coverage probability of approximately 95 %. It is the smallest measurement uncertainty that a laboratory can achieve within its scope of accreditation when performing calibrations of a best existing device. The measurement uncertainty reported on a calibration certificate may be greater than that provided in the CMC due to the behavior of the calibration item and other factors that may contribute to the uncertainty of a specific calibration.

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<sup>2</sup>When uncertainty is stated in relative terms (such as percent, a multiplier expressed as a decimal fraction or in scientific notation), it is in relation to instrument reading or instrument output, as appropriate, unless otherwise indicated.

<sup>3</sup>Capability is suitable for the calibration of measuring devices in the stated ranges.

<sup>4</sup>Capability is suitable for the calibration of devices intended to generate the indicated quantity in the stated ranges.

<sup>5</sup>Also available as site calibration. Note that actual measurement uncertainties achievable at a customer's site can normally be expected to be larger than the uncertainties listed on this Scope of Accreditation.

gal = gallon (Imperial)

VSWR = voltage standing wave ratio