



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

PHOENIX CALIBRATION
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CALIBRATION

Valid To: January 31, 2021

Certificate Number: 3022.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations^{1, 7}:

I. Acoustical Quantities

Parameter/Equipment	Range	CMC ² (±)	Comments
Sound Level Meters ³ – (74 to 114) dB	(0.125 to 2) kHz (>2 to 4) kHz	0.12 dB 0.2 dB	Sound level calibrator
Acoustical Calibrator ³ – (74 to 114) dB	(0.125 to 2) kHz (>2 to 4) kHz	0.15 dB 0.29 dB	Sound level meter

II. Chemical

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Conductivity Meters ³ – Fixed Points	1 μS/cm 10 μS/cm 25 μS/cm 50 μS/cm 100 μS/cm 147 μS/cm 1410 μS/cm 10 mS/cm 150 mS/cm	0.56 μS/cm 0.30 μS/cm 0.39 μS/cm 0.77 μS/cm 2.2 μS/cm 2.4 μS/cm 25 μS/cm 31 μS/cm 520 μS/cm	Conductivity standard solution
Resistivity Simulation	(1 to 100) pS/cm 100 pS/cm to 1 μS/cm 1 μS/cm to 1 mS/cm	0.58 pS/cm + 1.2 % 0.58 pS/cm + 3.5 % 0.58 pS/cm + 0.12 %	Decade box
pH Meters ³ – Fixed points	4.00 pH 7.00 pH 10.00 pH	0.014 pH 0.014 pH 0.014 pH	pH buffer solution
pH (mV simulation)	(4.00 to 10.00) pH	0.000 58 pH	Multifunction calibrator
TDS Meters ³ (Total Dissolved Solid)	0.39 ppm 6.99 ppm 65.7 ppm 6658 ppm 100 000 ppm	0.37 ppm 0.20 ppm 1.5 ppm 21 ppm 340 ppm	TDS solution

III. Dimensional

Parameter/Equipment	Range	CMC ² (±)	Comments
Gage Blocks	(0.050 to 4) in (4 to 6) in (6 to 20) in	1.9 μin + 0.95 μin/in 1.9 μin + 1 μin/in 2.1 μin + 1.4 μin/in	Gage blocks

Parameter/Equipment	Range	CMC ² (±)	Comments
Cylindrical Gages	(0.0115 to 0.75) in	11 μin + 6.8 μin/in	Laser micrometer and master pin gages
Calipers ³ – Outside, Inside, Step, and Depth	Up to 24 in	290 μin + 2.5 μin/in	Gage blocks
Micrometers ³ – Outside, Inside, and Depth	Up to 24 in	29 μin + 2.5 μin/in	Gage blocks
Dial Indicators ³	Up to 8 in	32 μin + 2.5 μin/in	Gage blocks
Surface Plate ³ – Flatness Overall	Up to (60 in x 60 in)	96 μin + 0.031 μin/in	Granite planekator-grade AA and test indicator
Rulers and Tapes ³	(0.05 to 36) in	0.0029 in + 10 μin/in	NIST SOP 10: gauge blocks
	(3 to 100) ft	0.0085 in + 120 μin/in	NIST SOP 12: precision rulers
Sieves – Opening Size Wire Diameter	(0.020 to 125) mm	1.6 μm + 0.79 nm/mm	ASTM E11: Measuring microscope
	(0.020 to 125) mm	13 μm + 0.79 nm/mm	Caliper

IV. Dimensional Testing

Parameter/Equipment	Range	CMC ^{2, 6} (\pm)	Comments
1D Dimensional Measurement –			
Length	Up to 4 in (4 to 8) in (8 to 240) in	46 μ in + 0.031 μ in 390 μ in + 0.031 μ in 0.0015 in + 0.031 μ in	Measuring microscope Digital caliper
Radius	Up to 4 in (4 to 80) in (8 to 240) in	46 μ in + 0.031 μ in 390 μ in + 0.031 μ in 0.0015 in + 0.031 μ in	Measuring microscope Digital caliper
Angle	0° to 180°	0.24° + 0.29 ppm	Measuring microscope
Luer Conical Fittings –			
Diameter and Length	Up to 50 mm	0.91 μ m + 0.79 nm/mm	ISO 594/1 and ISO 594/2: Measuring microscope

V. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 5} (\pm)	Comments
DC Current ³ – Generate	(0 to 220) μ A 220 μ A to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A (2.2 to 10) A (10 to 20) A	0.0071 μ A + 46 μ A/A 0.016 μ A + 40 μ A/A 0.15 μ A + 40 μ A/A 1.6 μ A + 52 μ A/A 27 μ A + 92 μ A/A 680 μ A + 420 μ A/A 470 μ A + 580 μ A/A	Multifunction calibrator Multifunction calibrator with transconductance amplifier
DC Current ³ – Measure	(0 to 100) μ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A (1.1 to 30) A (30 to 1000) A	0.92 pA + 13 μ A/A 0.008 μ A + 13 μ A/A 0.085 μ A + 15 μ A/A 0.8 μ A + 42 μ A/A 11 μ A + 200 μ A/A 10 μ A + 240 μ A/A 10 mA + 1 mA/A	8.5 digit digital multimeter 8.5 digit digital multimeter with current shunt

Parameter/Equipment	Range	CMC ^{2,5} (\pm)	Comments
DC Voltage ³ – Generate	(0 to 0.22) V (0.22 to 2.2) V (2.2 to 22) V (22 to 220) V (220 to 1100) V	0.46 μ V + 8.7 μ V/V 1.2 μ V + 5.8 μ V/V 4.3 μ V + 4.2 μ V/V 76 μ V + 5.8 μ V/V 1.1 mV + 7.5 μ V/V	Multifunction calibrator with transconductance amplifier
	(1.1 to 10) kV	0.012 kV + 14 V/kV	High voltage generator (hypot)/ high voltage probe
DC Voltage ³ – Measure	(0 to 0.1) V (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	0.54 μ V + 0.87 μ V/V 2.6 μ V + 5.7 μ V/V 6.9 μ V + 6.2 μ V/V 300 μ V + 8.4 μ V/V 3500 μ V + 8.4 μ V/V	Precision multimeter
DC Voltage ³ – Measure and Generate	(1 to 25) kV (25 to 100) kV	0.004 kV + 0.05 % 0.004 kV + 0.031 %	Voltage divider
Resistance ³ – Generate, Fixed Points	0.0001 Ω 0.000 165 Ω 0.0002 Ω 0.000 25 Ω 0.005 Ω 0.001 Ω 0.002 Ω	1.5 $\mu\Omega$ 23 n Ω 0.58 $\mu\Omega$ 1.2 $\mu\Omega$ 2.3 $\mu\Omega$ 1.3 $\mu\Omega$ 0.59 $\mu\Omega$	Current shunts
	0.1 Ω 0.2 Ω 0.3 Ω 0.4 Ω 0.5 Ω 0.6 Ω 0.7 Ω 0.8 Ω 0.9 Ω 0 Ω 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 k Ω 1.9 k Ω	2.5 $\mu\Omega$ 2.5 $\mu\Omega$ 2.5 $\mu\Omega$ 2.5 $\mu\Omega$ 2.5 $\mu\Omega$ 2.5 $\mu\Omega$ 2.5 $\mu\Omega$ 2.5 $\mu\Omega$ 2.5 $\mu\Omega$ 58 $\mu\Omega$ 130 $\mu\Omega$ 240 $\mu\Omega$ 310 $\mu\Omega$ 590 $\mu\Omega$ 1.4 m Ω 2.6 m Ω 10 m Ω 22 m Ω	Resistance box with digital multimeter Multifunction calibrator

Parameter/Equipment	Range	CMC ^{2,5} (\pm)	Comments
Resistance ³ – Generate, Fixed Points (cont)	10 k Ω 19 k Ω 100 k Ω 190 k Ω 1 M Ω 1.9 M Ω 10 M Ω 19 M Ω 100 M Ω 1000 M Ω 10 G Ω 50 G Ω 100 G Ω 1 T Ω	120 m Ω 0.22 Ω 1.5 Ω 2.9 Ω 27 Ω 53 Ω 540 Ω 1.2 k Ω 14 k Ω 6 M Ω 350 M Ω 0.58 G Ω 3.5 G Ω 35 G Ω	Multifunction calibrator Resistance box
Resistance – Measure and Generate	(0.0001 to 0.010) Ω (0.01 to 1) Ω (1 to 10) Ω (10 to 100) Ω (100 to 1000) Ω (1 to 10) k Ω (10 to 100) k Ω (100 to 1000) k Ω (1 to 10) M Ω (10 to 100) M Ω (100 to 1000) M Ω (1 to 10) G Ω (10 to 100) G Ω (100 to 1000) G Ω	5.8 $\mu\Omega$ + 8.7 $\mu\Omega/\Omega$ 7.3 $\mu\Omega$ + 20 $\mu\Omega/\Omega$ 45 $\mu\Omega$ + 14 $\mu\Omega/\Omega$ 200 $\mu\Omega$ + 12 $\mu\Omega/\Omega$ 1.5 m Ω + 11 $\mu\Omega/\Omega$ 11 m Ω + 13 $\mu\Omega/\Omega$ 0.95 Ω + 14 $\mu\Omega/\Omega$ 3.9 Ω + 16 $\mu\Omega/\Omega$ 61 Ω + 21 $\mu\Omega/\Omega$ 3.4 k Ω + 480 $\mu\Omega/\Omega$ 230 k Ω + 2.1 m Ω/Ω 46 M Ω + 2.7 m Ω/Ω 520 M Ω + 27 m Ω/Ω 5 G Ω + 27 m Ω/Ω	Precision multimeter, resistance box
Capacitance ³ – Measure, 1 kHz	(0 to 10) pF (10 to 100) pF (0.1 to 1) nF (1 to 10) nF (0.010 to 1) μ F (1 to 10) μ F (10 to 100) μ F (100 to 1000) μ F	0.21 pF + 0.021 pF/pF 0.023 pF + 0.023 % 3.2 pF + 0.2 % 82 pF + 1.2 pF/nF 82 pF + 0.93 mF/F 82 pF + 1.1 mF/F 82 pF + 1.9 mF/F 82 pF + 10 mF/F	Precision LCR meter

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Capacitance – Measure, Fixed Points			
1 kHz	1 μF 10 μF 100 μF 1 mF 10 mF	0.0029 μF 0.034 μF 0.34 μF 0.0039 mF 0.15 mF	Standard capacitors
100 Hz, 120 Hz	1 μF 10 μF 100 μF 1 mF 10 mF 100 mF	0.0029 μF 0.031 μF 0.31 μF 0.0035 mF 0.11 mF 1.1 mF	
Capacitance – Measure, 1 kHz	(0.0001 to 0.5) nF (0.0005 to 1.5) μF (1.5 to 10) μF (10 to 100) μF	0.1 pF 82 pF + 1.1 mF/F 0.58 nF + 1.2 mF/F 0.58 nF + 2 mF/F	Decade capacitance box
Inductance ³ – Measure			
100 kHz and 1 kHz	(1 to 100) μH (0.0001 to 1) H	100 pH + 3.3 mH/H 100 nH + 0.95 mH/H	Precision LCR meter

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation of Thermocouple Temperature Indicators ³ –			
Type B	600 °C to 800 °C 800 °C to 1000 °C 1000 °C to 1550 °C 1550 °C to 1820 °C	0.54 °C 0.46 °C 0.47 °C 0.53 °C	Temperature simulator in sourcing mode
Type C	0 °C to 150 °C 150 °C to 650 °C 650 °C to 1000 °C 1000 °C to 1800 °C 1800 °C to 2 316 °C	0.35 °C 0.31 °C 0.37 °C 0.58 °C 0.97 °C	
Type E	-250 °C to -100 °C -100 °C to -25 °C -25 °C to 350 °C 350 °C to 650 °C 650 °C to 1000 °C	0.58 °C 0.22 °C 0.18 °C 0.19 °C 0.25 °C	
Type J	-210 °C to -100 °C -100 °C to -30 °C -30 °C to 150 °C 150 °C to 760 °C 760 °C to 1 200 °C	0.32 °C 0.24 °C 0.19 °C 0.21 °C 0.27 °C	
Type K	-270 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 1000°C 1000 °C to 1372°C	0.38 °C 0.25°C 0.3 °C 0.46 °C 0.46 °C	
Type L	-200 °C to -100 °C -100 °C to 800 °C 800 °C to 900 °C	0.43 °C 0.30 °C 0.20 °C	
Type N	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 410 °C 410 °C to 1300 °C	0.47 °C 0.28 °C 0.23 °C 0.22 °C 0.32 °C	
Type R	0 °C to 250 °C 250 °C to 400 °C 400 °C to 1000 °C 1000 °C to 1750 °C	0.68 °C 0.42°C 0.4°C 0.47°C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation of Thermocouple Temperature Indicators ³ –			
Type S	0 °C to 250 °C 250 °C to 400 °C 400 °C to 1000 °C 1000 °C to 1750 °C	0.66 °C 0.43 °C 0.44 °C 0.55 °C	Temperature simulator in sourcing mode
Type T	-250 °C to -150 °C -150 °C to 0 °C 0 °C to 120 °C 120 °C to 400 °C	0.73 °C 0.28 °C 0.19 °C 0.17 °C	
Type U	-200 °C to 0 °C 0 °C to 600 °C	0.65 °C 0.32 °C	
Electrical Simulation of Thermocouple Simulators ³ –			
Type B	600 °C to 800 °C 800 °C to 1 000 °C 1000 °C to 1 550 °C 1550 °C to 1820 °C	0.54 °C 0.46 °C 0.47 °C 0.52 °C	Temperature simulation meter in measuring mode
Type C	0 °C to 150 °C 150 °C to 650 °C 650 °C to 1000 °C 1000 °C to 1800 °C 1800 °C to 2316 °C	0.35 °C 0.3 °C 0.36 °C 0.58 °C 0.97 °C	
Type E	-250 °C to -100 °C -100 °C to -25 °C -25 °C to 350 °C 350 °C to 650 °C 650 °C to 1000 °C	0.58 °C 0.21 °C 0.17 °C 0.19 °C 0.24 °C	
Type J	-210 °C to -100 °C -100 °C to -30 °C -30 °C to 150 °C 150 °C to 760 °C 760 °C to 1200 °C	0.31 °C 0.23 °C 0.19 °C 0.20 °C 0.27 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation of Thermocouple Simulators ³ – (cont)			
Type K	-270 °C to -100 °C	0.38 °C	Temperature simulation meter in measuring mode
	-100 °C to -25 °C	0.25 °C	
	-25 °C to 120 °C	0.30 °C	
	120 °C to 1000 °C	0.46 °C	
	1000 °C to 1372 °C	0.46 °C	
Type L	-200 °C to -100 °C	0.43 °C	
	-100 °C to 800 °C	0.30 °C	
	800 °C to 900 °C	0.20 °C	
Type N	-200 °C to -100 °C	0.46 °C	
	-100 °C to -25 °C	0.28 °C	
	-25 °C to 120 °C	0.22 °C	
	120 °C to 410 °C	0.21 °C	
	410 °C to 1300 °C	0.31 °C	
Type R	0 °C to 250 °C	0.67 °C	
	250 °C to 400 °C	0.41 °C	
	400 °C to 1000 °C	0.39 °C	
	1000 °C to 1750 °C	0.47 °C	
Type S	-20 °C to 250 °C	0.55 °C	
	250 °C to 1000 °C	0.42 °C	
	1000 °C to 1400 °C	0.43 °C	
	1400 °C to 1767 °C	0.54 °C	
Type T	-250 °C to -150 °C	0.73 °C	
	-150 °C to 0 °C	0.28 °C	
	0 °C to 120 °C	0.19 °C	
	120 °C to 400 °C	0.16 °C	
Type U	-200 °C to 0 °C	0.65 °C	
	0 °C to 600 °C	0.31 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation of RTD Temperature Simulators ³ –			
PT100 (385)	-200 °C to -80 °C -80 °C to 100 °C 100 °C to 300 °C 300 °C to 400 °C 400 °C to 630 °C 630 °C to 800 °C	0.014 °C 0.023 °C 0.035 °C 0.040 °C 0.054 °C 0.066 °C	Temperature simulation meter in measuring mode
PT100 (3926)	-200 °C to -80 °C -80 °C to 0 °C 0 °C to 100 °C 100 °C to 300 °C 300 °C to 400 °C 400 °C to 630 °C	0.013 °C 0.017 °C 0.022 °C 0.034 °C 0.039 °C 0.053 °C	
PT100 (3916)	-200 °C to -190 °C -190 °C to -80 °C -80 °C to 0 °C 0 °C to 100 °C 100 °C to 260 °C 260 °C to 300 °C 300 °C to 400 °C 400 °C to 600 °C 600 °C to 630 °C	0.0071 °C 0.014 °C 0.018 °C 0.022 °C 0.033 °C 0.034 °C 0.039 °C 0.052 °C 0.054 °C	
PT200 (385)	-200 °C to -80 °C -80 °C to 0 °C 0 °C to 100 °C 100 °C to 260 °C 260 °C to 300 °C 300 °C to 400 °C 400 °C to 630 °C	0.011 °C 0.015 °C 0.020 °C 0.025 °C 0.061 °C 0.066 °C 0.087 °C	
PT500 (385)	-200 °C to -80 °C -80 °C to 0 °C 0 °C to 100 °C 100 °C to 260 °C 260 °C to 300 °C 300 °C to 400 °C 400 °C to 630 °C	0.0093 °C 0.023 °C 0.029 °C 0.038 °C 0.041 °C 0.047 °C 0.061 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation of RTD Temperature Simulators ³ – (cont)			
PT1000 (385)	-200 °C to -80 °C -80 °C to 0 °C 0 °C to 100 °C 100 °C to 260 °C 260 °C to 300 °C 300 °C to 400 °C 400 °C to 630 °C	0.014 °C 0.017 °C 0.023 °C 0.032 °C 0.035 °C 0.039 °C 0.054 °C	Temperature simulation meter in measuring mode
PtNi (385), 120Ω	-80 °C to 0 °C 0 °C to 100 °C 100 °C to 260 °C	0.012 °C 0.013 °C 0.014 °C	
Cu 427, 10Ω	-100 °C to 260 °C	0.08 °C	
YS1400	15 °C to 50 °C	0.0081 °C	
25 Ω SPRT3	-200 °C to 660 °C	0.023 °C	
Electrical Simulation of RTD Indicators ³ –			
PT100 (385)	-200 °C to -80 °C -80 °C to 100 °C 100 °C to 630 °C 630 °C to 800 °C	0.081 °C 0.12 °C 0.10 °C 0.12 °C	Temperature simulator in source mode
PT100 (3926)	-200 °C to 0 °C 0 °C to 300 °C 300 °C to 630 °C	0.081 °C 0.093 °C 0.10 °C	
PT100 (3916)	-200 °C to -190 °C -190 °C to 300 °C 300 °C to 630 °C	0.081 °C 0.093 °C 0.10 °C	
PT200 (385)	-200 °C to 260 °C 260 °C to 400 °C 400 °C to 630 °C	0.047 °C 0.50 °C 0.58 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation of RTD Indicators ³ – (cont)			
PT500 (385)	-200 °C to -80 °C -80 °C to 0 °C 0 °C to 100 °C 100 °C to 300 °C 300 °C to 400 °C 400 °C to 630 °C	0.024 °C 0.17 °C 0.18 °C 0.20 °C 0.21 °C 0.22 °C	Temperature simulator in source mode
PT1000 (385)	-200 °C to -80 °C -80 °C to 260 °C 260 °C to 630 °C	0.081 °C 0.093 °C 0.10 °C	
PtNi 385, 120 Ω (Ni120)	-80 °C to 0 °C 0 °C to 100 °C 100 °C to 260 °C	0.059 °C 0.047 °C 0.036 °C	
Cu 427, 10 Ω	-100 °C to 260 °C	0.87 °C	
YS1400	15 °C to 50 °C	0.01 °C	

Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
AC Current ³ – Generate			
(0 to 20) μA	(0.1 to 1) kHz (1 to 10) kHz	9.2 nA + 140 pA/μA 88 pA + 320 pA/μA	Multifunction calibrator
(20 to 220) μA	(0.04 to 1 kHz (1 to 5) kHz (5 to 10) kHz	9.2 μA + 140 pA/μA 14 pA + 320 pA/μA 110 pA + 1.3 nA/μA	
(0.22 to 2.2) mA	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	20 nA + 160 μA/A 480 pA + 690 μA/A 1 μA + 1.8 mA/A	
(2.2 to 22) mA	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	600 pA + 140 μA/A 1.7 μA + 230 μA/A 8.1 μA + 1.3 mA/A	
(22 to 220) mA	(0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	6.4 μA + 140 μA/A 17 μA + 230 μA/A 58 μA + 1.3mA/A	

Parameter/Range	Frequency	CMC ^{2, 5} (\pm)	Comments
AC Current ³ – Generate (cont)			
(0.22 to 2.2) A	(0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	100 μ A + 300 μ A/A 270 μ A + 520 μ A/A 0.97mA + 8.1 mA/A	Multifunction calibrator
(2.2 to 11) A	(0.040 to 1) kHz (1 to 5) kHz (5 to 10) kHz	4.8 mA + 0.9 mA/A 11 mA + 1 mA/A 39 mA + 1.7 mA/A	
(11 to 20) A	(0.040 to 1) kHz	2.3 mA + 1.2 mA/A	Multifunction calibrator with transconductance amplifier
AC Current ³ – Measure			8.5 digit digital multimeter
(0 to 100) μ A	40 Hz to 1 kHz	26 nA + 810 μ A/A	
(0.1 to 1) mA	40 Hz to 1 kHz	0.14 μ A + 460 μ A/A	
(1 to 10) mA	40 Hz to 1 kHz	2.4 μ A + 460 μ A/A	
(10 to 100) mA	40 Hz to 1 kHz	31 μ A + 460 μ A/A	
(0.1 to 1.05) A	40 Hz to 1 kHz	260 μ A + 690 μ A/A	
(1.05 to 30) A	(0.04 to 1) kHz	17 mA + 1.2 mA/A	
AC Voltage ³ – Generate			
(0 to 2.2) mV	(0.04 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1 000) kHz	4.7 μ V + 92 μ V/V 4.8 μ V + 92 μ V/V 5.8 μ V + 580 μ V/V 8.1 μ V + 980 μ V/V 13 μ V + 1.2 mV/V 23 μ V + 1.6 mV/V 23 μ V + 3.1 mV/V	Multifunction calibrator
(2.2 to 22) mV	(0.04 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1 000) kHz	4.8 μ V + 92 μ V/V 4.8 μ V + 92 μ V/V 5.5 μ V + 0.23 mV 6.5 μ V + 580 μ V/V 13 μ V + 1.2 mV/V 26 μ V + 1.6 mV/V 26 μ V + 3.1 mV/V	

Parameter/Range	Frequency	CMC ^{2, 5} (\pm)	Comments
AC Voltage ³ – Generate (cont)			
(22 to 220) mV	(0.04 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1 000) kHz	9 μ V + 92 μ V/V 9 μ V + 92 μ V/V 11 μ V + 230 μ V/V 21 μ V + 530 μ V/V 31 μ V + 1 mV/V 67 μ V + 1.6 mV/V 64 μ V + 3.1 mV/V	Multifunction calibrator
(0.22 to 0.5) V	(0.04 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	12 μ V + 52 μ V/V 12 μ V + 52 μ V/V 23 μ V + 87 μ V/V 23 μ V + 87 μ V/V 100 μ V + 480 μ V/V 260 μ V + 1.2 mV/V 260 μ V + 1.2 mV/V	
(0.5 to 1) V	(0.04 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	14 μ V + 52 μ V/V 12 μ V + 52 μ V/V 23 μ V + 87 μ V/V 40 μ V + 130 μ V/V 100 μ V + 480 μ V/V 0.34 mV + 1.2 mV/V 0.43 mV + 2 mV/V	
(1 to 2) V	(0.04 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	22 μ V + 52 μ V/V 22 μ V + 52 μ V/V 42 μ V + 87 μ V/V 53 μ V + 130 μ V/V 120 μ V + 480 μ V/V 0.55 mV + 1.2 mV/V 0.61 mV + 2 mV/V	

Parameter/Range	Frequency	CMC ^{2, 5} (\pm)	Comments
AC Voltage ³ – Generate (cont)			
(2 to 22) V	(0.04 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1 000) kHz	210 μ V + 52 μ V/V 210 μ V + 52 μ V/V 420 μ V + 87 μ V/V 460 μ V + 120 μ V/V 1.4 mV + 0.32 mV/V 6.8 mV + 1.2 mV/V 7.4 mV + 1.7 mV/V	Multifunction calibrator
(22 to 220) V	(0.04 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	2.5 mV + 0.060 mV/V 2.5 mV + 0.060 mV/V 6.1 mV + 0.092 mV/V 6.7 mV + 0.17 mV/V	
(220 to 1100) V	(0.05 to 1) kHz	18 mV + 0.081 mV/V	
(1.1 to 40) kV	(60) Hz	8.2 V + 5 V/kV	High voltage generator (hypot)/HV probe
AC Voltage ³ – Measure			
(1 to 100) mV	10 Hz to 1 kHz (1 to 20) kHz (20 to 100) kHz	97 μ V + 3.5 mV/V 120 μ V + 0.46 mV/V 0.59 mV + 0.92 mV/V	8.5 digit digital multimeter
(0.1 to 1) V	10 Hz to 1 kHz (1 to 20) kHz (20 to 100) kHz (100 to 1 MHz)	1.7 mV + 5.8 mV/V 0.97 mV + 0.23 mV/V 1.1 mV + 0.92 mV/V 31 mV + 13 mV/V	
(1 to 10) V	(10 to 1) kHz (1 to 20) kHz (20 to 100) kHz 100 kHz to 200 kHz	0.41 mV + 0.23 mV/V 9.7 mV + 0.46 mV/V 9.7 mV + 0.92 mV/V 0.03 V + 0.013 V/V	
(10 to 100) V	(10 Hz to 1) kHz (1 to 20) kHz (20 to 50) kHz	6.9 mV + 0.23 mV/V 90 mV + 0.58 mV/V 90 mV + 1.2 mV/V	
(100 to 1000) V	(10 Hz to 1) kHz (1 to 10) kHz	30 mV + 0.23 mV/V 0.73 V + 0.12 mV	
(1 to 40) kV	(60) Hz	8.2 V + 5 V/kV	8.5 digit digital multimeter/high voltage probe

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
AC Current ³ – Generate, Clamp-On Ammeters Toroidal	(11 to 1000) A	110 mA + 4.4 mA/A	Multifunction calibrator with 50- Coils
AC Current ³ – Measure, Clamp-On Ammeters Toroidal	(0 to 400) A (400 to 1000) A	17 mA + 23 mA/A 0.59 A + 23 mA/A	Current clamps
Oscilloscopes ³ – Amplitude – (Up to 120) V (Peak-to-Peak) Frequency Sweep Time Base Bandwidth Level	Up to 10 kHz (10 to 500) MHz (5 to 50.00) MHz (10 to 500) MHz	0.82 mV + 0.12 mV/V 1.5 µHz + 5.9 µHz/Hz 0.59 µHz + 5.9 µHz/Hz 0.12 mHz + 1 µHz/Hz	Multifunction calibrator

VI. Fluid Quantities

Parameter/Equipment	Range	CMC ^{2,4,6} (±)	Comments
Volumetric Flow Measuring Devices – Gas (Air) ³	(50 to 250) cm ³ /min	0.058 cm ³ /min + 1.3 %	Air flow bubble flowmeter
Standard Conditions (Nominal) at 101.3 kPa and 21 °C	(250 to 30 000) cm ³ /min (60 to 300) L/min (100 to 650) ft ³ /min	0.12 cm ³ /min + 1.2 % 0.001 L/min + 2.4 % 9.2 ft ³ /min + 4.1 %	Air flowmeter

Parameter/Equipment	Range	CMC ^{2, 4, 6} (±)	Comments
Volumetric Flow Measuring Devices – Liquid ³	(0.001 to 1450) L/min	0.11 ml/min + 0.2 %	Weight standards with timer
	(Up to 21 000) L/min	0.58 ml/min + 2.2 %	Ultrasonic flow meter
	(5 to 100) L/min	2.7 ml/min + 0.012 %	Coriolis mass flow meter
Piston-operated volumetric apparatus: Pipettes and Burettes	(>1 to 10) µL (>10 to 100) µL (>100 to 1 000) µL (>1 000 to 10 000) µL	0.12 µL 0.14 µL 0.7 µL 6.2 µL	ISO 8655-6:2002: gravimetric method using analytical mass balances
Pipettes and Burettes	(>0.5 to 20) mL (>20 to 200) mL (>200 to 1000) mL	20 µL + 0.4 µL/L 98 µL + 0.5 µL/L 100 µL + 0.46 µL/L	NIST SOP 14: gravimetric method using analytical mass balances and mass standards
Volumetric Ware/ Equipment	(>0.5 to 20) mL (>20 to 200) mL (>200 to 1000) mL (>1000 to 10 000) mL (1 to 5) gal (5 to 100) gal	20 µL + 0.4 µL/L 98 µL + 0.5 µL/L 100 µL + 0.46 µL/L 1 mL + 0.68 µL/mL 22 mL + 0.68 µL/mL 220 mL + 0.68 µL/mL	NIST SOP 14: gravimetric method using analytical mass balances and mass standards
Specific Gravity (Relative Density) – Hydrometers	(0.60 to 0.70) (0.70 to 1.00) (1.00 to 2.00)	0.000 25 SG 0.0004 SG 0.000 81 SG	ASTM E126
Turbidity Meters ³	0.5 NTU 10 NTU 20 NTU 100 NTU 500 NTU 2000 NTU 4000 NTU	0.011 NTU 0.16 NTU 0.37 NTU 2.1 NTU 7.7 NTU 31 NTU 3.5 NTU	Stabilized Formazin turbidity standard

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Viscosity Meters ³	(3.7 to 5.2) cP (56 to 73) cP (101.1 to 1360 cP (215 to 687) cP (2100 to 9250) cP (11 000 to 17 000) cP (21 500 to 34 000) cP	0.0013 cP + 0.25 % 0.036 cP + 0.24 % 0.11 cP + 0.25 % 0.55 cP + 0.35 % 3.7 cP + 0.43 % 7.6 cP + 0.48 % 15 cP + 0.48 %	ASTM D341: Viscosity standard fluid Temperature (20 to 40) °C

VII. Mechanical

Parameter/Equipment	Range	CMC ² (±)	Comments
Durometer ³ – (Types: A, B, C, D, DO, E, M, O, OO, OOO, OOO-S, R)			ASTM D2240: DP = Duro point
Spring Calibration Force	(0 to 100) DP	0.12 DP	Standard weights
Indenter Extension and Shape			Measuring microscope
Diameter	Up to 0.5 in	120 μin	
Radius	(0.01 to 0.5) in	120 μin	
Angle	20° to 45°	0.059°	
Extension	Up to 0.5 in	120 μin	Gage blocks
Indenter Display	Up to 0.2 in	410 μin	
Indirect Verification of Rockwell Hardness Testers ³	HRC: Low Medium High HRBW: Low Medium High HR30N: Low Medium High	0.49 HRC 0.37 HRC 0.34 HRC 0.74 HRC 0.67 HRC 0.66 HRC 0.64 HRC 0.5 HRC 0.39 HRC	Indirect verification per ASTM E18

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Balances ³	(1 to 500) mg (500 mg to 10) g (10 g to 100) g (100 g to 500) g (500 g to 1 000) g (1 to 25) kg	1.6 µg + 0.81 µg/g 8.1 µg + 0.45 µg/g 24 µg + 0.36 µg/g 0.13 mg + 0.49 µg/g 0.53 mg + 0.4 µg/g 7.6 mg + 0.59 µg/g	Standards weights
High Capacity Scale ³ –	(25 to 500) kg (500 to 15 000) kg (15 000 to 60 000) kg	10 g + 1.4 g/25 kg 5.8 kg + 0.058 kg/500 kg 5.8 kg + 7.5 kg/ 15 000 kg	Standards weights Standard weights and substitution method, N = number of substitutions for every 15 000 kg
Electrical Simulation of Scale Display	(0 to 100 000) kg	9 kg + 0.058 g/kg	Process meter
Nuclear Surface Moisture and Density Gauge –			
Density	(1786 to 2600) kg/m ³	0.62 %	ASTM D7759: using verification standard for nuclear gauges
Moisture	(32.9 to 37.8) %	2.1 %	
Rotational Velocity – Tachometers ³	(5 to 1000) rpm (1000 to 10 000) rpm (10 000 to 100 000) rpm (100 000 to 500 000) rpm	0.11 rpm + 0.012 % 0.15 rpm 1.3 rpm + 0.0005 % 2 rpm + 0.005 %	Optical/contact tachometer
Rotational Velocity – Non-contact Tachometers	(0 to 1 000) rpm (1 000 to 10 000) rpm (10 000 to 50 000) rpm (50 000 to 100 000) rpm	0.043 rpm + 0.002 % 0.2 rpm 1.1 rpm 5.3 rpm	Standard stroboscope

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Torque Analyzers / Testers ³	Up to 2.5 in·lbf (2.5 to 25) in·lbf (25 to 250) in·lbf (250 to 12 000) in·lbf	0.0026 in·lbf + 0.075 % 0.0066 in·lbf + 0.035 % 0.0082 in·lbf + 0.000 85 % 0.58 in·lbf + 0.14 %	ASMT E2624: torque arms, weights
Torque Tools ³	(2.5 to 25) in·lbf (25 to 250) in·lbf (250 to 12 000) in·lbf	0.031 in·lbf + 0.09 % 0.027 in·lbf + 1.2 % 0.11 in·lbf + 0.58 %	Torque analyzers
Force ³ – Tension Testing Machines Compression Testing Machines Tension/ Compression Gauges	(20 to 1000) lbf (1000 to 100 000) lbf (20 to 1000) lbf (10 000 to 100 000) lbf (100 000 to 500 000) lbf Up to 20 lbf (20 to 100) lbf (100 to 1000) lbf (1000 to 30 000) lbf	0.5 lbf + 0.058 % 1.2 lbf + 0.07 % 0.5 lbf + 0.058 % 1.2 lbf + 0.07 % 1.2 lbf + 0.077 % 0.000 005 8 lbf + 0.0023 % 0.000 058 ozf + 0.013 % 0.000 058 ozf + 0.017 % 0.12 lbf + 0.012 %	ASTM E4 with standard load cells Weight standards
Pressure and Vacuum Gauges ³ – Pneumatic Hydraulic Pneumatic/ Hydraulic	(-14 to 0) psig (-2000 to +2000) Pa (10 to 300) mmHg (1 to 300) psig (14.5 to 530) psig (530 to 10 150) psig (10 150 to 36 000) psig	0.0041 psig 0.058 Pa + 0.42 % 0.001 mmHg + 0.058 % 0.0001 psig + 0.017 % 0.000 01 psig + 0.017 % 0.001 psig + 0.018 % 7.4 psig + 0.004 %	EURAMET Guide 17: Vacuum gauge Differential pressure calibrator Dead weight ball gauge Hydraulic dead weight tester Digital pressure gauge

Parameter/Equipment	Range	CMC ^{2, 4, 6} (±)	Comments
Weights, Including Laboratory Weights and Masses – ASTM Classes 1, 2, 3, 4, 5, 6 & 7; OIML Classes E2, F1, F2, M1, M2 & M3	(1 to 500) mg	0.0017 mg	NIST SOP # 4, 5 and 8 procedures using standard weights and mass comparators
	(1 to 5) g	0.01 mg	
	10 g	0.014 mg	
	20 g	0.015 mg	
	50 g	0.037 mg	
	100 g	0.05 mg	
	200 g	0.077 mg	
	500 g	0.34 mg	
	1 kg	0.66 mg	
	2 kg	3.9 mg	
	5 kg	7.7 mg	
	10 kg	39 mg	
	(20 to 25) kg	99 mg	
500 kg	950 mg		

VIII. Optical Quantities

Parameter/Equipment	Range	CMC ² (±)	Comments
Colorimeters ³	(0 to 0.18) mg/L	0.051 mg/L	Ozone (Mid-Range) Color Standards
	(0.18 to 0.46) mg/L	0.061 mg/L	
	(0.46 to 0.69) mg/L	0.071 mg/L	DPD Chlorine HR Color Standards
	(0.69 to 1.8) mg/L	0.22 mg/L	
	(1.8 to 3.4) mg/L	0.32 mg/L	
	(3.4 to 6.1) mg/L	0.61 mg/L	
Illuminance – Light Meters	(4 to 450) fc	0.012 fc + 0.044 fc/fc	Reference light meter
Polarimeter ³ – Optical Rotation			
Wavelength, (325 to 633) nm	10.818° to 46.736°	0.0061°	Quartz control plate
Refraction Index Meters ³	1.332990 nD 1.34782 nD 1.38118 nD 1.39980 nD 1.42006 nD	0.000 03 nD + 0.43 ppm 0.000 081 nD + 0.43 ppm 0.000 091 nD + 0.43 ppm 0.000 19 nD+ 0.43 ppm 0.000 21 nD+ 0.43 ppm	Refractive index calibration standards

Parameter/Equipment	Range	CMC ² (±)	Comments
Transmittance ³ / Absorbance ³ – Spectrophotometers	90 %T / 0.046 A 30 %T / 0.523 A 10 %T / 1.000 A	0.0033 A 0.0046 A 0.0048 A	Transmission and absorbance glass filter certified reference materials
Wavelength – Spectrophotometers	(230 to 660) nm	0.19 nm	Holmium Oxide solution wavelength certified reference material

IX. Thermodynamics

Parameter/Equipment	Range	CMC ² (±)	Comments
Temperature ³ – Digital & Mechanical Thermometers and Temperature Probes	(-197 to -38) °C (-38 to 0) °C (0 to 232) °C (232 to 420) °C (420 to 660) °C (660 to 1200) °C	0.027 °C + 0.0081 % 0.025 °C + 0.0081 % 0.026 °C + 0.0081 % 0.027 °C + 0.0081 % 0.049 °C + 0.046 % 2.5 °C + 0.038 %	Digital indicator with PRT Digital indicator with thermocouple
Temperature ³ – Liquid-in- Glass Thermometers	(-38 to 105) °C (95 to 205) °C (195 to 405) °C	0.13 °C 0.24 °C 0.58 °C	Digital indicator with PRT
Temperature ³ – Measure Temperature Chambers, Ovens, Freezers	(-40 to 0) °C (0 to 232) °C (232 to 420) °C (420 to 660) °C (660 to 1200) °C	0.024 °C 0.029 °C 0.12 °C 0.25 °C 2.5 °C + 0.038 %	Digital indicator with PRT Digital indicator with thermocouple
Temperature Blocks	(-40 to 0) °C (0 to 232) °C (232 to 420) °C (420 to 660) °C	0.03 °C 0.034 °C 0.067 °C 0.24 °C	Digital indicator with temperature sensor

Parameter/Equipment	Range	CMC ^{2,4,6} (±)	Comments
Infrared Temperature Thermometer ³	(-20 to 0) °C (0 to 100) °C (100 to 420) °C	0.063 °C + 0.69 % 0.074 °C + 0.69 % 0.086 °C + 0.69 %	Platinum resistance probe and display
Relative Humidity ³ – Measuring Equipment	(0.25 to 10) % RH (10 to 35) % RH (35 to 80) % RH (80 to 95) % RH	0.96 % RH 0.97 % RH 0.97 % RH 1 % RH	Relative humidity meter and humidity generator
Relative Humidity ³ – Measure	(0.25 to 10) % RH (10 to 35) % RH (35 to 80) % RH (80 to 95) % RH	0.95 % RH 0.99 % RH 0.97 % RH 1 % RH	Relative humidity meter

X. Time & Frequency

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Frequency – Measure	(0 to 300) MHz	120 µHz + 10 µHz/Hz	Frequency counter
Frequency – Measuring Equipment	Up to 10 MHz	1.5 µHz + 18 µHz/Hz	Multifunction calibrator
Frequency Sweep – Measuring Equipment	(10 to 500) MHz	1.5 µHz + 5.9 µHz/Hz	Multifunction calibrator
Time Base (Pulse) – Generate	5 Hz to 50 MHz	0.59 µHz + 5.9 µHz/Hz	Multifunction calibrator
Time – Measure	(0 to 86 400) s	0.1 ms + 0.012 ms/s	Frequency counter

¹ This laboratory offers commercial calibration service and field calibration service.

- ² Calibration and Measurement Capability Uncertainty (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. CMCs represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of $k = 2$. The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.
- ³ Field calibration service is available for this calibration and this laboratory meets A2LA R104 – *General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for these calibrations. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the actual uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.
- ⁴ In the statement of CMC, percentage indicates percent of reading, unless otherwise noted.
- ⁵ The stated measured values are determined using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure or generate the measured value in the ranges indicated. CMCs are expressed as either a specific value that covers the full range or as a percent or fraction of the reading plus a fixed floor specification.
- ⁶ The type of instrument or material being calibrated is defined by the parameter. This indicates the laboratory is capable of calibrating instruments that measure or generate the values in the ranges indicated for the listed measurement parameter.
- ⁷ This scope meets A2LA's *P112 Flexible Scope Policy*.

MECHANICAL TESTING

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory¹ to perform the following test on fume hoods, bio-safety cabinets, HEPA Filter.

Test:	Test Methods:
BioSafety Cabinets, Class II, Type A1, A2, B1 and B2	NSF/ANSI 49 Annex F, except F.7 (site installation assessment) and F.8 (electrical leakage and ground circuit resistance and polarity)
Laboratory Fume Hood (as installed, as used)	ASHRAE 110
Controlled Environment - Containment Leak	ISO 14644-3 at B.13: photometer method

¹ This laboratory meets A2LA R104 – *General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for all tests listed. Accreditation is granted for field testing activities at this location only, and only applies to field technicians that are based out of this location.





Accredited Laboratory

A2LA has accredited

PHOENIX CALIBRATION

Santo Domingo, DOMINICAN REPUBLIC

for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of R205 – Specific Requirements: Calibration Laboratory Accreditation Program. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).



Presented this 9th day of April 2019.

A handwritten signature in blue ink, positioned above a horizontal line.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3022.01
Valid to January 31, 2021
Revised December 29, 2020

For the calibrations to which this accreditation applies, please refer to the laboratory's Calibration Scope of Accreditation.