



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005
& ANSI/NCSL Z540-1-1994

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CALIBRATION

Valid To: March 31, 2018

Certificate Number: 1888.05

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations and dimensional inspections¹:

I. Chemical

Parameter/Equipment	Range	CMC ² (±)	Comments
pH Measuring Equipment ³	(4.01, 7.0, 10.0) pH units	0.034 pH units	pH buffer solutions
Conductivity ³ – Liquid	(0 to 10) µS (>10 to 100) µS (>100 to 1413) µS (>1413 to 10 000) µS	0.68 µS 0.57 µS 6.0 µS 54 µS	Conductivity solutions

II. Dimensional

Parameter/Equipment	Range	CMC ^{2,4} (\pm)	Comments
Calipers ³	Up to 80 in	$(400 + 60L) \mu\text{in} + 0.60R$	Gage blocks
Micrometers ³	Up to 80 in	$(30 + 65L) \mu\text{in} + 0.60R$	Gage blocks
Height Gages ³	Up to 80 in	$(300 + 62L) \mu\text{in} + 0.60R$	Gage blocks
Dial, Digital, Test, Bore & Co-Axial Indicators ³	Up to 4 in	$(10 + 25L) \mu\text{in} + 0.60R$	Gage blocks
Rigid Rulers ³	Up to 80 in	0.010 in	Gage blocks
Tape Measures	Up to 100 ft	0.014 in per foot	Master rule
Feeler Gages ³	Up to 1 in	200 μin	OD micrometer
Optical Comparator and Vision Machines ³ X-Y Linearity	Up to 6 in	$250 \mu\text{in} + 0.60R$	Glass master
Protractors ³	0° to 360°	$0.025^\circ + 0.60R$	Angle blocks

III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 5, 6} (\pm)	Comments
DC Voltage – Generate ³	Up to 330 mV 330 mV to 3.3 V (3.3 to 33) V (33 to 330) V (330 to 1000) V	21 μ V/V + 1.0 μ V 12 μ V/V + 2.0 μ V 13 μ V/V + 20 μ V 19 μ V/V + 150 μ V 19 μ V/V + 1.5 mV	Fluke 5522A
DC Voltage – Measure ³	(0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1000) V (1 to 9) kV (9 to 90) kV	10 μ V/V + 3.0 μ V 9 μ V/V + 3.0 μ V 9 μ V/V + 5.0 μ V 11 μ V/V + 30 μ V 11 μ V/V + 100 μ V 0.036 % 0.67 %	Agilent 3458A Vitrek 4700 Vitrek 4700 with HVL-4700
DC Current – Generate ³	Up to 330 μ A (330 μ A to 3.3 mA (3.3 to 33) mA (33 to 330) mA 330 mA to 1.1 A (1.1 to 3.0) A (3.0 to 11) A (11 to 20.5) A	0.016 % + 0.020 μ A 0.011 % + 0.030 μ A 0.011 % + 0.20 μ A 0.011 % + 2.5 μ A 0.021 % + 40 μ A 0.039 % + 40 μ A 0.051 % + 500 μ A 0.10 % + 750 μ A	Fluke 5522A
Clamp-on only	(20.5 to 1025) A	0.50 % + 0.50 A	Fluke 5520A/coil
DC Current – Measure ³	(10 to 100) μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A (1 to 3) A 3 A to 2 kA (2 to 10) kA	22 μ A/A + 1.0 nA 22 μ A/A + 5.0 nA 22 μ A/A + 50 nA 37 μ A/A + 0.50 nA 0.012 % + 10 μ A 0.13 % + 0.60 mA 0.25 % 1.0 %	Agilent 3458A Agilent 34401A Empro shunts

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Resistance – Generate ³	(0 to 11) Ω (11 to 33) Ω (33 to 110) Ω 110 Ω to 1.1 kΩ (1.1k to 11k) Ω (11 to 110) kΩ 110 k to 1.1 MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110)MΩ (110 to 330)MΩ (330 to 1100) MΩ	40 μΩ/Ω + 1.0 mΩ 30 μΩ/Ω + 1.5 mΩ 28 μΩ/Ω + 1.4 mΩ 28 μΩ/Ω + 2.0 mΩ 28 μΩ/Ω + 20 mΩ 28 μΩ/Ω + 0.20 Ω 32 μΩ/Ω + 2.0 Ω 60 μΩ/Ω + 30 mΩ 0.013 % + 50 Ω 0.025 % + 2.5 kΩ 0.05 % + 3.0 kΩ 0.30 % + 100 kΩ 1.5 % + 500 kΩ	Fluke 5522A
Resistance – Measure ³	(0 to 10) Ω (10 to 100) Ω (100 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1 GΩ	20 μΩ/Ω + 50 μΩ 15 μΩ/Ω + 0.50 mΩ 13 μΩ/Ω + 1.1 mΩ 18 μΩ/Ω + 2.0 Ω 50 μΩ/Ω + 100 Ω 0.060 % + 1.0 kΩ 0.50 % + 10 kΩ	Agilent 3458A
Capacitance – Generate ³	(0.19 to 3.3) nF (3.3 to 330) nF 330 nF to 3.3 μF (3.3 to 33) μF (33 to 330) μF 330 μF to 3.3 mF (3.3 to 33) mF (33 to 110) mF	0.50 % + 0.01 nF 0.25 % + 0.30 nF 0.20 % + 3.0 nF 0.40 % + 30 nF 0.45 % + 300 nF 0.45 % + 3.0 μF 0.75 % + 30 μF 0.66 % + 100 μF	Fluke 5522A
Capacitance – Generate Fixed Points ³	(0.001, 0.01, 0.1) μF 1 μF (0 to 1.1) μF	0.16 % 0.070 %	GR 1409 series Quad Tech 1413

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Capacitance – Measure ³ at 1 kHz	(0 to 1120) μF	0.27 %	GR 1689
Inductance – Generate ³ at 1 kHz	1 mH	0.42 %	GR 1482-E
	10.0 mH	0.12 %	GR1482-H
	100 mH	0.12 %	GR1482-L
Inductance – Measure ³	1 μH to 100 H	0.27 %	GR 1689
Electrical Calibration of Thermocouple Indicators ³ –			Fluke 5522A
Type B	600 °C to 800 °C	0.49 °C	
	800 °C to 1000 °C	0.40 °C	
	1000 °C to 1550 °C	0.36 °C	
	1550 °C to 1800 °C	0.31 °C	
Type C	0 °C to 150 °C	0.28 °C	
	150 °C to 650 °C	0.23 °C	
	650 °C to 1000 °C	0.28 °C	
	1000 °C to 1800 °C	0.45 °C	
	1800 °C to 2316 °C	0.73 °C	
Type E	-250 °C to -100 °C	0.05 °C	
	-100 °C to -25 °C	0.15 °C	
	-25 °C to 350 °C	0.13 °C	
	350 °C to 650 °C	0.16 °C	
	650 °C to 1000 °C	0.20 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of Thermocouple Indicators ³ – (cont)			
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	0.32 °C 0.15 °C 0.13 °C 0.17 °C 0.22 °C	Fluke 5522A
Type K	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 1000 °C 1000 °C to 1372 °C	0.30 °C 0.17 °C 0.15 °C 0.23 °C 0.35 °C	
Type L	-200 °C to -100 °C -100 °C to 800 °C 800 °C to 900 °C	0.43 °C 0.31 °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	0.36 °C 0.20 °C 0.18 °C 0.17 °C 0.25 °C	
Type R	0 °C to 250 °C 250 °C to 400 °C 400 °C to 1000 °C 1000 °C to 1767 °C	0.56 °C 0.33 °C 0.31 °C 0.36 °C	
Type S	0 °C to 250 °C 250 °C to 1000 °C 1000 °C to 1400 °C 1400 °C to 1767 °C	0.55 °C 0.35 °C 0.33 °C 0.40 °C	
Type T	-250 °C to -150 °C -150 °C to 0 °C 0 °C to 120 °C 120 °C to 400 °C	0.56 °C 0.22 °C 0.15 °C 0.13 °C	
Type U	-200 °C to 0 °C 0 °C to 600 °C	0.65 °C 0.32 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of RTDs ³ –			
Pt 385, 100 Ω	-200 °C to 0 °C 0 °C to 100 °C 100 °C to 300 °C 300 °C to 630 °C 630 °C to 800 °C	0.063 °C 0.083 °C 0.10 °C 0.12 °C 0.25 °C	Fluke 5522A
Pt 3926, 100 Ω	-200 °C to 0 °C 0 °C to 300 °C 300 °C to 630 °C	0.06 °C 0.10 °C 0.12 °C	
Pt 3916, 100 Ω	-200 °C to -190 °C -190 °C to 0 °C 0 °C to 260 °C 260 °C to 600 °C 600 °C to 630 °C	0.29 °C 0.07 °C 0.08 °C 0.10 °C 0.27 °C	
Pt 385, 200 Ω	-200 °C to 260 °C 260 °C to 630 °C	0.060 °C 0.17 °C	
Pt 385, 500 Ω	-200 °C to 260 °C 260 °C to 400 °C 400 °C to 630 °C	0.060 °C 0.090 °C 0.11 °C	
Pt 385, 1000 Ω	-200 °C to 260 °C 260 °C to 600 °C 600 °C to 630 °C	0.050 °C 0.080 °C 0.26 °C	
Ni 120, 120 Ω	-80 °C to 100 °C 100 °C to 260 °C	0.090 °C 0.16 °C	
Cu 427 10 Ω	-100 °C to 260 °C	0.35 °C	

Parameter/Range	Frequency	CMC ^{2, 5, 6} (±)	Comments
AC Voltage – Generate ³			
(1 to 33) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.080 % + 6.0 μV 0.015 % + 6.0 μV 0.02 % + 6.0 μV 0.10 % + 6.0 μV 0.36 % + 12 μV 0.80 % + 50 μV	Fluke 5522A
(33 to 330) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.030 % + 8.0 μV 0.015 % + 8.0 μV 0.016 % + 8.0 μV 0.035 % + 8.0 μV 0.080 % + 32 μV 0.20 % + 70 μV	
(0.33 to 3.3) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.030 % + 50 μV 0.015 % + 60 μV 0.019 % + 60 μV 0.030 % + 50 μV 0.070 % + 130 μV 0.24 % + 600 μV	
(3.3 to 33) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.030 % + 650 μV 0.015 % + 600 μV 0.024 % + 600 μV 0.035 % + 600 μV 0.090 % + 1.6 mV	
(33 to 330) V	45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.019 % + 2.0 mV 0.020 % + 6.0 mV 0.025 % + 6.0 mV 0.030 % + 6.0 mV 0.20 % + 6.0 mV	
(330 to 1020) V	45 Hz to 10 kHz	0.030 % + 10 mV	

Parameter/Range	Frequency	CMC ^{2,5,6} (±)	Comments
AC Voltage – Measure ³			
(1 to 10) mV	(10 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.031 % rdg + 0.030 % rng 0.021 % rdg + 0.010 % rng 0.031 % rdg + 0.010 % rng 0.011 % rdg + 0.010 % rng 0.51 % rdg + 0.010 % rng 4.1 % rdg + 0.020 % rng	Agilent 3458A
(10 to 100) mV, 100 mV to 1 V, (1 to 10) V	(10 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz	0.0080 % rdg + 0.0050 % rng 0.0080 % rdg + 0.0020 % rng 0.015 % rdg + 0.0020 % rng 0.031 % rdg + 0.0020 % rng 0.081 % rdg + 0.0020 % rng 0.031 % rdg + 0.010 % rng 2.0 % rdg + 0.010 % rng 2.0 % rdg + 0.010 % rng	
(10 to 100) V	(10 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.021 % rdg + 0.0040 % rng 0.021 % rdg + 0.0020 % rng 0.021 % rdg + 0.0020 % rng 0.036 % rdg + 0.0020 % rng 0.13 % rdg + 0.0020 % rng 0.41 % rdg + 0.013 % rng 1.8 % rdg + 0.010 % rng	
(100 to 750) V	(10 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.041 % rdg + 0.0040 % rng 0.041 % rdg + 0.0020 % rng 0.061 % rdg + 0.0020 % rng 0.13 % rdg + 0.0020 % rng 0.31 % rdg + 0.0020 % rng	
750 V to 9 kV	(50 to 60) Hz	0.45 %	Vitrek 4700
(9 to 70) kV	(50 to 60) Hz	1.5 %	Vitrek 4700 with HVL-4700

Parameter/Range	Frequency	CMC ^{2, 6} (\pm)	Comments
AC Current – Generate ³			
(29 to 330) μ A	(10 to 20) Hz (20 to 45) Hz (0.45 to 1) kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.03 % rdg + 6.0 μ A 0.15 % rdg + 1.0 μ A 0.13 % rdg + 0.1 μ A 0.3 % rdg + 0.20 μ A 0.8 % rdg + 0.10 μ A 1.6 % rdg + 0.50 μ A	Fluke 5522A
330 μ A to 3.3 mA	(10 to 20) Hz (20 to 45) Hz (0.45 to 1) kHz (1 to 5) kHz (5 to 30) kHz	0.20 % rdg + 17 μ A 0.14 % rdg + 16 μ A 0.11 % rdg + 15 μ A 0.20 % rdg + 0.30 μ A 0.90 % rdg + 0.60 μ A	
(3.3 to 33) mA	(10 to 20) Hz (20 to 45) Hz (0.45 to 1) kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.20 % rdg + 5.0 μ A 0.20 % rdg + 15 μ A 0.12 % rdg + 15 μ A 0.08 % rdg + 2.0 μ A 0.19 % rdg + 3.0 μ A 1.0 % rdg + 6.0 μ A	
(33 to 330) mA	(10 to 20) Hz (20 to 45) Hz (0.45 to 1) kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.18 % rdg + 20 μ A 0.50 % rdg + 50 μ A 0.050 % rdg + 5.0 μ A 0.10 % rdg + 50 μ A 0.15 % rdg + 75 μ A 0.40 % rdg + 500 μ A	
330 mA to 1.1 A	(10 to 45) Hz (0.45 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.19 % rdg + 300 μ A 0.050 % rdg + 200 μ A 0.10 % rdg + 500 μ A 3.0 % rdg + 2.0 mA	
(1.1 to 3) A	(10 to 45) Hz (0.45 to 1) kHz (1 to 10) kHz	0.18 % rdg + 100 μ A 0.80 % rdg + 600 μ A 0.80 % rdg + 1.0 mA	
(3 to 11) A	(45 to 100) Hz (0.1 to 1) kHz (1 to 5) kHz	1.8 % rdg + 5.0 mA 2.5 % rdg + 5.0 mA 3.0 % rdg + 5.0 mA	
(11 to 20.5) A	(45 to 100) Hz (0.1 to 5) kHz	1.0 % rdg + 500 mA 2.5 % rdg + 500 mA	

Parameter/Range	Frequency	CMC ^{2, 5, 6} (\pm)	Comments
AC Current – Generate ³ (cont) Clamp-on only (20.5 to 1025) A	(45 to 65) Hz (65 to 440) Hz	0.80 % 0.99 %	Fluke 5522A w/Fluke 50-turn coil
AC Current – Measure ³ (5 to 100) μ A	(10 to 20) Hz (20 to 45) Hz 45 Hz to 5 kHz	0.45 % rdg + 0.030 % rng 0.18 % rdg + 0.030 % rng 0.80 % rdg + 0.030 % rng	Agilent 3458A
AC Current – Measure ³ (cont) (1, 10, 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.41 % rdg + 0.020 % rng 0.16 % rdg + 0.020 % rng 0.07 % rdg + 0.020 % rng 0.04 % rdg + 0.020 % rng 0.40 % rdg + 0.040 % rng 0.42 % rdg + 0.040 % rng 0.56 % rdg + 0.16 % rng	Agilent 3458A
1 A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz	0.42 % rdg + 0.020 % rng 0.16 % rdg + 0.020 % rng 0.10 % rdg + 0.020 % rng 0.12 % rdg + 0.020 % rng 0.35 % rdg + 0.020 % rng 0.35 % rdg + 0.020 % rng	Agilent 3458A
3 A	(3 to 5) Hz (5 to 10) Hz 10 Hz to 5 kHz	1.2 % rdg + 0.060 % rng 0.37 % rdg + 0.060 % rng 0.17 % rdg + 0.060 % rng	HP 34401A
3 A to 1 kA	45 Hz to 5 kHz	0.80 %	AEMC clamp-on meter

IV. Mechanical

Parameter/Equipment	Range	CMC ^{2, 4, 5} (±)	Comments	
Universal Testing Machines, Compression Testing Machines and Tension Testing Machines ³	(0.2 to 600) lbf	0.04 % + 0.58R	Deadweights, ASTM E4	
	Up to 600 000 lbf	0.4 % + 0.58R	Load cells; The range for testing machines in tension is only to 60 000 lbf. ASTM E4	
Pressure Gages and Transducers ³ –				
	Hydraulic ³	(10 to 15 000) psi	0.25 % rdg + 0.60R	Ametek T150 deadweight tester
	Pneumatic ³	Up to 300 psi	0.11 psig + 0.60R	Druck pressure gage calibrator
		Up to 100 psi	0.0025 psi + 0.012 % of Transducer Range	Fluke PPC2+
Vacuum	Up to 29.9 inHg	0.005 inHg + 0.012 % of Transducer Range	Fluke PPC2+	
Torque ³ –				
	Wrenches	20 in·oz to 600 ft·lbf	1.0 %	Master dead weight standards, master length standard, CDI Datatest 950-DT
	Analyzers	(10 to 2400) in·lbf	0.1 %	Class F weights and various torque wheels and arms
Guns, Drivers, Screwdrivers	(0.2 to 250) Nm	0.40 %	Crane and Norbar torque transducers	

V. Time & Frequency

Parameter/Equipment	Range	CMC ² (\pm)	Comments
Frequency – Measure ³	10 Hz to 500 MHz 500 MHz to 18 GHz	0.011 μ Hz/Hz 0.002 μ Hz/Hz	HP 5334B, HP 5343A
Frequency – Measuring Equipment ³	(10 to 500) MHz	20 μ Hz/Hz	HP 3325B, Fluke 5522A

¹ This laboratory offers commercial calibration service, field calibration service, and dimensional testing service.

² Calibration and Measurement Capability (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. Calibration and Measurement Capabilities 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, L is the length of the unit under test in inches; D is the diagonal of the unit under test in inches; and R is the resolution of the device under test.

⁵ In the statement of CMC, the first percentage given is the percentage of the reading, unless otherwise noted; the second percentage or fraction given is a percentage or fraction of the range.

⁶ 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. CMC's 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.