



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

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CALIBRATION

Valid To: February 28, 2021

Certificate Number: 1741.12

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations^{1, 8}:

I. Chemical

Parameter/Equipment	Range	CMC ² (±)	Comments
pH Meters ³ – Fixed Points	4 pH 7 pH 10 pH	0.032 pH 0.027 pH 0.05 pH	Standard pH solutions
Conductivity Meters ³	10 µS/cm 100 µS/cm 1000 µS/cm 1413 µS/cm 10 000 µS/cm	0.56 µS/cm 0.37 µS/cm 2.3 µS/cm 5.4 µS/cm 42 µS/cm	Standard conductivity solutions

II. Dimensional

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Pin Gage ³ – Class Z & Class ZZ	Up to 1 in	110 µin	Micrometer
Calipers ³	Up to 40 in	(4.5 + 9.9L) µin + 0.6R	Gage blocks
Micrometers ³	Up to 40 in	(4.5 + 9.9L) µin + 0.6R	Gage blocks

Parameter/Equipment	Range	CMC ^{2,5} (\pm)	Comments
Linear Indicators ³ – Dial, test & LVDT	Up to 4 in	$(3.0 + 9.4L) \mu\text{in} + 0.6R$	Gage blocks
Height Gages ³	Up to 20 in (20 to 48) in	$(52 + 7.9L) \mu\text{in} + 0.6R$ $(18 + 9.6L) \mu\text{in} + 0.6R$	Gage blocks
Steel Rules ³	Up to 72 in	$(1.5 + 10L) \mu\text{in} + 0.6R$	Gage blocks
Tape Measures ³	Up to 25 ft	$(1.5 + 10L) \mu\text{in} + 0.6R$	Gage blocks
Angle Indicators & Protractors ³	30°, 45°, 60°, 75°, 90°	0.03°	Angle block set
Feeler/Thickness Gages ³	Up to 1 in	110 μin	Micrometer
Laser Micrometers ³	Up to 1 in	$(20 + 3.7L) \mu\text{in} + 0.6R$	Master setting discs
Diameter /Radius/Fixture Gages – Diameter Radius Length	Up to 6.0 in Up to 6.0 in Up to 6.0 in	460 μin 460 μin 460 μin	Vision machine
Surface Plates ³ – Grades AA, A, & B Repeatability Flatness	0.002 in Up to 60 DL in (>60 to 120) DL in	40 μin $(31 + 0.2DL) \mu\text{in}$ $(30 + 0.3DL) \mu\text{in}$	Repeat-o-meter Federal level systems
Vision systems ³ X-Y Linearity Z Axis	Up to 18 in Up to 4 in	$(52 + 2.9L) \mu\text{in}$ 60 μin	Grid plate Gage blocks

III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,4,6} (±)	Comments	
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	0.011 % 0.0057 % 0.0049 % 0.0062 % 0.0067 %	Agilent 34401A	
	(1 to 6) kV	1.3 %	Fluke 80K-6 & DMM	
	(6 to 7) kV	2.4 %	Fluke 80K-40 & DMM	
DC Voltage – Generate ³	(0 to 330) mV (0 to 3.3) V (0 to 33) V (30 to 330) V (100 to 1000) V	25 μV/V + 1 μV 14 μV/V + 2 μV 15 μV/V + 15 μV 22 μV/V + 150 μV 22 μV/V + 1.5 mV	Fluke 5520A	
DC Current – Measure ³	(1 to 10) mA (10 to 100) mA 100 mA to 1 A	0.039 % 0.043 % 0.1 %	Agilent 34401A	
	(1 to 50) A	0.31 %	Empro shunt w/ DMM	
DC Current– Generate ³	(0 to 330) μA (0 to 3.3) mA (0 to 33) mA (0 to 330) mA (0 to 1.1) A (1.1 to 3) A (0 to 11) A (11 to 21) A	0.018 % + 0.02 μA 0.012 % + 0.05 μA 0.012 % + 0.25 μA 0.012 % + 2.5 μA 0.024 % + 40 μA 0.046 % + 40 μA 0.06 % + 500 μA 0.12 % + 750 μA	Fluke 5520A	
	Clamp-On Meters ³ Toroidal	(20.5 to 1000) A	0.39 % + 0.5 A	Fluke 5520A w/5500 coil
	Non Toroidal	(20.5 to 1000) A	0.65 % + 0.5 A	

Parameter/Equipment	Range	CMC ^{2,4,6} (±)	Comments
Resistance – Measure ³	(0 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ	0.017 % 0.014 % 0.014 % 0.014 % 0.014 % 0.05 % 0.98 %	Agilent 34401A
Resistance – Generate ³	(0 to 11) Ω (11 to 33) Ω (33 to 110) Ω 110 Ω to 1.1 kΩ (1.1 to 11) kΩ (11 to 110) kΩ 110 kΩ 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	49 μΩ/Ω + 0.001 Ω 37 μΩ/Ω + 0.0015 Ω 34 μΩ/Ω + 0.0014 Ω 34 μΩ/Ω + 0.002 Ω 34 μΩ/Ω + 0.02 Ω 34 μΩ/Ω + 0.2 Ω 39 μΩ/Ω + 2 Ω 73 μΩ/Ω + 30 Ω 0.016 % + 50 Ω 0.03 % + 2.5 kΩ 0.06 % + 3 kΩ 0.36 % + 100 kΩ 1.8 % + 500 kΩ	Fluke 5520A

Parameter/Range	Frequency	CMC ^{2,4,6} (±)	Comments
Capacitance – Generate ³ (0.19 to 10.9999) nF (11 to 109.999) nF (110 to 329.999) nF (0.33 to 1.09 999) μF (1.1 to 3.29 999) μF (3.3 to 10.9 999) μF (11 to 32.9 999) μF (33 to 109.999) μF (110 to 329.999) μF 330 μF to 10.999 mF (11 to 32.9 999) mF (33 to 110) mF	(10 to 1000) Hz (10 to 1000) Hz (10 to 1000) Hz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz (0 to 50) Hz (0 to 2) Hz (0 to 0.60) Hz (0 to 0.20) Hz	0.61 % + 0.01 nF 0.31 % + 0.1 nF 0.31 % + 0.3 nF 0.31 % + 1 nF 0.31 % + 3 nF 0.31 % + 10 nF 0.49 % + 30 nF 0.56 % + 100 nF 0.56 % + 300 nF 0.56 % + 10 μF 0.91 % + 30 μF 2.2 % + 100 μF	Fluke 5520A



Parameter/Range	Frequency	CMC ^{2,4,6} (±)	Comments
AC Voltage – Generate ³			
(1 to 33) mV	(10 to 45) Hz	0.096 % + 6 μV	Fluke 5520A
	45 Hz to 10 kHz	0.019 % + 6 μV	
	(10 to 20) kHz	0.025 % + 6 μV	
	(20 to 50) kHz	0.12 % + 6 μV	
	(50 to 100) kHz	0.42 % + 12 μV	
	(100 to 500) kHz	0.96 % + 50 μV	
(33 to 330) mV	(10 to 45) Hz	0.036 % + 8 μV	Fluke 5520A
	45 Hz to 10 kHz	0.018 % + 8 μV	
	(10 to 20) kHz	0.02 % + 8 μV	
	(20 to 50) kHz	0.042 % + 8 μV	
	(50 to 100) kHz	0.096 % + 32 μV	
	(100 to 500) kHz	0.24 % + 70 μV	
(0.33 to 3.3) V	(10 to 45) Hz	0.036 % + 50 μV	Fluke 5520A
	45 Hz to 10 kHz	0.019 % + 60 μV	
	(10 to 20) kHz	0.023 % + 60 μV	
	(20 to 50) kHz	0.036 % + 50 μV	
	(50 to 100) kHz	0.084 % + 130 μV	
	(100 to 500) kHz	0.29 % + 600 μV	
(3.3 to 33) V	(10 to 45) Hz	0.036 % + 650 μV	Fluke 5520A
	45 Hz to 10 kHz	0.019 % + 600 μV	
	(10 to 20) kHz	0.029 % + 600 μV	
	(20 to 50) kHz	0.042 % + 600 μV	
	(50 to 100) kHz	0.11 % + 1.6 mV	
	(100 to 500) kHz	0.29 % + 600 μV	
(33 to 330) V	45 Hz to 1 kHz	0.023 % + 2 mV	Fluke 5520A
	(1 to 10) kHz	0.025 % + 6 mV	
	(10 to 20) kHz	0.03 % + 6 mV	
	(20 to 50) kHz	0.036 % + 6 mV	
	(50 to 100) kHz	0.24 % + 50 mV	
	(100 to 500) kHz	0.29 % + 600 μV	
(330 to 1020) V	45 Hz to 10 kHz	0.036 % + 10 mV	Fluke 5520A
AC Voltage – Measure ³			
	10 Hz to 20 kHz	0.12 %	Agilent 34401A
	(20 to 50) kHz	0.21 %	
	(50 to 100) kHz	0.82 %	
	60 Hz	1.6 %	Fluke 80K-6 & DMM
	60 Hz	6 %	Fluke 80K-40 & DMM

Parameter/Range	Frequency	CMC ^{2,4,6} (±)	Comments
AC Current – Generate ³			
(0 to 0.33) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.24 % + 0.1 μA 0.18 % + 0.1 μA 0.15 % + 0.1 μA 0.36 % + 0.15 μA 0.96 % + 0.2 μA 2 % + 0.4 μA	Fluke 5520A
(0.33 to 3.3) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.25 % + 0.15 μA 0.16 % + 0.15 μA 0.13 % + 0.15 μA 0.25 % + 0.2 μA 0.6 % + 0.3 μA 1.2 % + 0.6 μA	
(3.3 to 33) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.22 % + 2 μA 0.11 % + 2 μA 0.05 % + 2 μA 0.096 % + 2 μA 0.24 % + 3 μA 0.48 % + 4 μA	
(33 to 330) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.22 % + 20 μA 0.11 % + 20 μA 0.05 % + 20 μA 0.12% + 50 μA 0.24 % + 100 μA 0.48 % + 200 μA	
(0.33 to 1.1) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.22 % + 100 μA 0.06 % + 100 μA 0.72 % + 1 mA 3 % + 5 mA	
(1.1 to 3) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.22 % + 100 μA 0.072 % + 100 μA 0.72 % + 1 mA 3 % + 5 mA	
(3 to 11) A	45 Hz to 1 kHz (1 to 5) kHz	0.12 % + 2 mA 3.6 % + 2 mA	
(11 to 20.5) A	45 Hz to 1 kHz (1 to 5) kHz	0.18 % + 5 mA 3.6 % + 5 mA	

Parameter/Range	Frequency	CMC ^{2, 4, 6, 7} (\pm)	Comments
AC Current – Generate ³ (cont)			
Clamp-On Meters ³ – (10 to 150) A			
Toroidal	(45 to 65) Hz (65 to 440) Hz	0.49 % + 0.025 A 1 % + 0.027 A	Fluke 5520A w/ 5500 coil
Non Toroidal	(45 to 65) Hz (65 to 440) Hz	0.76 % + 0.25 A 1.3 % + 0.25 A	
(150 to 1025) A			
Toroidal	(45 to 65) Hz (65 to 440) Hz	0.49 % + 0.09 A 1 % + 0.1 A	
Non Toroidal	(45 to 65) Hz (65 to 440) Hz	0.76 % + 0.9 A 1.3 % + 0.9 A	
AC Current – Measure ³			
(0 to 1) A	10 Hz to 5 kHz	0.18 %	Agilent 34401A
(1 to 3) A	10 Hz to 5 kHz	0.26 %	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Thermocouple Simulation ³ –			
Type B	(600 to 800) °C (800 to 1820) °C	0.54 °C 0.42 °C	Fluke 5520A
Type E	(-250 to -100) °C (-100 to 650) °C (650 to 1000) °C	0.61 °C 0.22 °C 0.28 °C	
Type J	(-210 to -100) °C (-100 to 760) °C (760 to 1200) °C	0.34 °C 0.23 °C 0.30 °C	
Type K	(-200 to -100) °C (-100 to 1000) °C (1000 to 1372) °C	0.41 °C 0.33 °C 0.49 °C	
Type N	(-200 to -100) °C (-100 to 410) °C (410 to 1300) °C	0.49 °C 0.29 °C 0.34 °C	
Type R	(0 to 250) °C (250 to 1000) °C (1000 to 1767) °C	0.70 °C 0.41 °C 0.49 °C	
Type S	(0 to 250) °C (250 to 1400) °C (1400 to 1767) °C	0.58 °C 0.46 °C 0.57 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 400) °C	0.76 °C 0.31 °C 0.22 °C	
Electrical Calibration of RTD ³ s –			
Source	(-200 to 200) °C (200 to 600) °C (600 to 850) °C	0.19 °C 0.31 °C 0.43 °C	Beamex MC2-MF
Measure	(-200 to 200) °C (200 to 600) °C (600 to 850) °C	0.19 °C 0.31 °C 0.43 °C	

IV. Mechanical

Parameter/Equipment	Range	CMC ^{2,5,6,7} (±)	Comments
Scales & Balances ³	(1 to 500) mg Up to 5 g Up to 10 g Up to 30 g Up to 50 g Up to 100 g Up to 200 g Up to 300 g Up to 500 g Up to 1000 g (> 1 to 35) kg (5 to 10) g (10 to 500) g 501 g to 20 kg (> 20 to 5000) kg Up to 1000 lb (1000 to 120 000) lb	0.013 mg + 0.6R 0.043 mg + 0.6R 0.062 mg + 0.6R 0.096 mg + 0.6R 0.17 mg + 0.6R 0.31 mg + 0.6R 0.63 mg + 0.6R 0.92 mg + 0.6R 1.5 mg + 0.6R 3.1 mg + 0.6R 3.1 mg per 1000 g + 0.6R 0.04 % + 0.6R 0.025 % + 0.6R 0.017 % + 0.6R 0.017 % per 20 kg + 0.6R 0.017 % + 0.6R 0.017 % per 1000 lb + 0.6R	ASTM Class 1 weights (applied load) Class F weights (applied load) Class F weights (applied load)
Force ³	Up to 1000 lbf Up to 10 000 lbf	0.017 % + 0.6R 0.14 % of Applied	Class F weights Load cells w/ indicator
Tensile Tester ³			
Speed / Rate	Up to 50 in/min	0.025 %	Timer & caliper
Displacement	Up to 20 Inches	0.00 025 in	Gage blocks w/ indicator
Torque - Measure ³ – Wrenches - Click, Dial, Adjustable, Screwdrivers	5 in·lbf to 600 ft·lbf	0.65 %	CDI Suretest 5000-ST
Rotary Torque– Measure ³ – Pneumatic, DC, Pulse	(0 to 180) N·m	1.3 % Full Scale	Crane-Torquestar w/ rotary transducers

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Pressure – Measure & Measuring Equipment ³			
Pneumatic	(0 to 1) in H ₂ O (0 to 4) in H ₂ O (0.01 to 30) psig	0.002 in H ₂ O 0.025 in H ₂ O 0.07 % Full Scale	Heise HM2-1 Dwyer 475 Beamex MC2-IPM2C
Hydraulic	(0 to 300) psig (0 to 1000) psig (5 to 10 000) psig	0.07 % Full Scale 0.07 % Full Scale 0.07 % Full Scale	Druck DPI-104
Atmospheric Pressure – Measure & Measuring Equipment (Vacuum) ³	(0.01 to 28.5) in Hg	0.02 in Hg	Beamex MC2-IPM2C
Speed ³ –			
Optic/Non-contact: RPM Totalizer/Rate Meters	(6 to 100 000) rpm (2 to 3300) fpm	0.017 % 0.017 %	Monarch PLT200
Contact: RPM Totalizer/Rate Meters	(6 to 20 000) rpm (2 to 3300) fpm	0.22 % 0.22 %	Shimpo 105A



V. Thermodynamics

Parameter/Equipment	Range	CMC ^{2,7} (\pm)	Comments
Relative Humidity – Measure ³	(10 to 80) % RH	1.5 % RH	Rotronic HP22A w/ HC2 Probe
Temperature – Measure ³	(-196 to 420) °C	0.34 °C	Agilent 34401A w/ RTD
Temperature – Measuring Equipment ³	(-15 to 110) °C (50 to 350) °C	0.3 °C 0.75 °C	Fluke 9009
Infrared Thermometry – Measuring Equipment ³	Up to 100 °C Up to 200 °C Up to 350 °C Up to 500 °C	1 °C 1.2 °C 1.7 °C 2.3 °C	Fluke 4181

VI. Time & Frequency

Parameter/Equipment	Range	CMC ² (\pm)	Comments
Timers & Stopwatches ³	(1 to 3600) s	0.2 s	Monarch PLT 200
Frequency – Measuring Equipment ³	0.01 Hz to 2 MHz	3.1 ppm + 5 μ Hz	Fluke 5520A

¹ This laboratory offers commercial calibration and field calibration services, where noted.

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 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.
- ⁵ The statement of CMC, L is the numerical value of the nominal length of the device measured in inches; R is the numerical value of the resolution of the device in micro inches, DL is the diagonal length of the device in inches.
- ⁶ In the statement of CMC, percentages are percent of reading, unless otherwise indicated.
- ⁷ 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.
- ⁸ This scope meets A2LA's P112 Flexible Scope Policy.



Accredited Laboratory

A2LA has accredited

J.A. KING

Lexington, SC

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 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 21st day of March 2019.

A blue ink signature of the Vice President of Accreditation Services, consisting of a stylized, cursive "A" followed by a horizontal line.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 1741.12
Valid to February 28, 2021

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