



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

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CALIBRATION

Valid To: August 31, 2019

Certificate Number: 1741.11

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. Dimensional

Parameter/Equipment	Range	CMC ^{2, 5, 7} (±)	Comments
Cylindrical Gages – Pin, Plug, Disc Gages ³ Plain Rings	Up to 12.0 in Up to 7.0 in	(25 + 8.7L) μin (25 + 8.7L) μin	Universal measuring machine (UMM)
Length Standards/Jo Blocks	Up to 4.0 in	(16 + 3.2L) μin	Universal measuring machine (UMM)
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
Linear Indicators ³ – Dial and Test	Up to 4 in	(3.0 + 9.4L) μin + 0.6R	Gage blocks
Height Gages ³	Up to 20 in (20 to 48) in	(2.5 + 10L) μin + 0.6R (9.5 + 9.7L) μin + 0.6R	Gage blocks
Steel Rules ³	Up to 72 in	(1.5 + 10L) μin + 0.6R	Gage blocks
Tape Measures ³	Up to 25 ft	(1.5 + 10L) μin + 0.6R	Gage blocks

Parameter/Equipment	Range ⁵	CMC ^{2, 5, 7} (±)	Comments
Angle Indicators and Protractors ³	15°, 30°, 45°, 60°, 75°, 90°	0.03°	Angle block set
Feeler/Thickness Gages ³	Up to 1 in	80 μin	Micrometer
Diameter /Radius/Fixture Gages ³ –			Optical comparator
Diameter	Up to 2.0 in	650 μin	
Radius	Up to 2.0 in	650 μin	
Length	Up to 12.0 in Up to 25.0 ft	650 μin 0.094 in	Tape measure
Optical Comparators ³ –			
X-Y Linearity	(0 to 12) in	150 μin	Glass master scales
Magnification	10x to 250x	0.014 in	
Angle	0° to 90°	0.1°	Angle block set
Surface Plates ³ – Grades AA, A, and B			
Repeatability	0.002 in	40 μin	Repeat-o-meter
Flatness	Up to 60 <i>DL</i> in (> 60 to 120) <i>DL</i> in	(31 + 0.2 <i>DL</i>) μin (30 + 0.3 <i>DL</i>) μin	Federal level systems

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 4, 7} (±)	Comments
DC Voltage – Generate ³	(0 to 330) mV 330 mV to 3.3 V (3.3 to 33) V (33 to 330) V (100 to 1020) V	73 μV/V + 3 μV 61 μV/V + 5 μV 61 μV/V + 50 μV 67 μV/V + 500 μV 69 μV/V + 1.5 mV	Fluke 5500A

Parameter/Equipment	Range	CMC ^{2, 4, 6, 7} (±)	Comments
DC Voltage – Measure ³	(0 to 100) mV	0.011 %	Agilent 34401A
	100 mV to 1 V	0.0057 %	
	(1 to 10) V	0.0049 %	
	(10 to 100) V	0.0062 %	
	(100 to 1000) V	0.0067 %	
DC Voltage – Measure ³	(1 to 6) kV	1.2 %	Fluke 80K-6 & DMM
	(6 to 20) kV	2.4 %	Fluke 80K-40 & DMM
	(20 to 35) kV	1.2 %	
	(35 to 40) kV	2.4 %	
DC Current – Measure ³	(1 to 10) mA	0.039 %	Agilent 34401A
	(10 to 100) mA	0.043 %	
	100 mA to 1 A	0.1 %	
DC Current – Measure ³	(1 to 100) A	0.25 %	Empro shunt w/ DMM
DC Current – Generate ³	(0 to 3.3) mA	0.016 % + 0.05 μA	Fluke 5500A
	(3.3 to 33) mA	0.013 % + 0.25 μA	
	(33 to 330) mA	0.013 % + 3.3 μA	
	330 mA to 2.2 A	0.037 % + 44 μA	
	(2.2 to 11) A	0.08 % + 330 μA	
Resistance – Measure ³	(0 to 100) Ω	0.017 %	Agilent 34401A
	100 Ω to 1 kΩ	0.014 %	
	(1 to 10) kΩ	0.014 %	
	(10 to 100) kΩ	0.014 %	
	100 kΩ to 1 MΩ	0.014 %	
	(1 to 10) MΩ	0.05 %	
	(10 to 100) MΩ	0.98 %	
Resistance – Generate ³	(0 to 11) Ω	0.015 % + 0.008 Ω	Fluke 5500A
	(11 to 33) Ω	0.015 % + 0.015 Ω	
	(33 to 330) Ω	0.011 % + 0.015 Ω	
	330 Ω to 3.3 kΩ	0.011 % + 0.06 Ω	
	(3.3 to 33) kΩ	0.011 % + 0.6 Ω	
	(33 to 110) kΩ	0.014 % + 6 Ω	
	(110 to 330) kΩ	0.015 % + 6 Ω	
	330 kΩ to 3.3 MΩ	0.019 % + 55 Ω	
	(3.3 to 11) MΩ	0.073 % + 550 Ω	

Parameter/Range	Frequency	CMC ^{2, 4, 6, 7} (±)	Comments
Capacitance – Generate ³ (0.33 to 11) nF (11 to 110) nF (110 to 330) nF (0.33 to 1.1) μF (1.1 to 3.3) μF (3.3 to 11) μF (11 to 33) μF (33 to 110) μF (110 to 330) μF 330 μF to 1.1 mF	(50 to 1000) Hz (50 to 1000) Hz (50 to 1000) Hz (50 to 1000) Hz (50 to 1000) Hz (50 to 400) Hz (50 to 400) Hz (50 to 200) Hz (50 to 100) Hz (50 to 100) Hz	1 % + 0.01 nF 0.32 % + 0.1 nF 0.32 % + 0.3 nF 0.32 % + 1 nF 0.43 % + 3 nF 0.44 % + 10 nF 0.5 % + 30 nF 0.63 % + 100 nF 0.86 % + 300 nF 1.3 % + 300 nF	Fluke 5500A
AC Voltage – Measure ³ (0 to 750) V (1 to 6) kV (6 to 40) kV	10 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz Up to 60 Hz Up to 60 Hz	0.12 % 0.21 % 0.82 % 1.2 % 6 %	Agilent 34401A Fluke 80K-6 & DMM Fluke 80K-40 & DMM
AC Voltage – Generate ³ (1 to 33) mV (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 (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	0.43 % + 20 μV 0.19 % + 20 μV 0.25 % + 20 μV 0.31 % + 20 μV 0.43 % + 33 μV 1.2 % + 60 μV 0.3 % + 50 μV 0.06 % + 20 μV 0.12 % + 20 μV 0.2 % + 40 μV 0.29 % + 170 μV 0.84 % + 330 μV	Fluke 5500A

Parameter/Range	Frequency	CMC ^{2, 4, 6, 7} (±)	Comments
AC Voltage – Generate ³ (cont)			
330 mV to 3.3 V	(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	0.18 % + 250 μV 0.037 % + 60 μV 0.097 % + 60 μV 0.17 % + 300 μV 0.29 % + 1.7 mV 0.6 % + 3.3 mV	Fluke 5500A
(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	0.19 % + 2.5 mV 0.05 % + 600 μV 0.1 % + 2.6 mV 0.23 % + 5 mV 0.29 % + 17 mV	
(33 to 330) V	45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz	0.06 % + 6.6 mV 0.1 % + 15 mV 0.11 % + 33 mV	
(330 to 1000) V	45 Hz to 1 kHz (1 to 5) kHz 5 kHz to 10 kHz	0.07 % + 80 mV 0.25 % + 100 mV 0.25 % + 500 mV	
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 %	
AC Current – Generate ³			
(29 to 330) μA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.3 % + 0.15 μA 0.15 % + 0.15 μA 0.15 % + 0.25 μA 0.48 % + 0.15 μA 1.5 % + 0.15 μA	Fluke 5500A
(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	0.24 % + 0.3 μA 0.12 % + 0.3 μA 0.12 % + 0.3 μA 0.24 % + 0.3 μA 0.72 % + 0.3 μA	

Parameter/Range	Frequency	CMC ^{2, 4, 6, 7} (±)	Comments
AC Current – Generate ³ (cont)			
(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	0.24 % + 3 µA 0.12 % + 3 µA 0.11 % + 3 µA 0.24 % + 3 µA 0.72 % + 3 µA	Fluke 5500A
(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	0.24 % + 30 µA 0.12 % + 30 µA 0.11 % + 30 µA 0.24 % + 30 µA 0.72 % + 30 µA	
330 mA to 2.2 A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz	0.24 % + 300 µA 0.12 % + 300 µA 0.9 % + 300 µA	
(2.2 to 11) A	(45 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz	0.08 % + 2 mA 0.12 % + 2 mA 0.4 % + 2 mA	

III. Mechanical

Parameter/Equipment	Range	CMC ^{2, 5, 7} (±)	Comments
Scales and 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	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	ASTM Class 1 weights (applied load)

Parameter/Equipment	Range	CMC ^{2, 5, 6, 7} (\pm)	Comments
Scales and Balances ³ (cont.)	Up to 1000 g (> 1 to 35) kg	3.1 mg + 0.6R 3.1 mg per 1000 g + 0.6R	ASTM Class 1 weights (applied load)
	(5 to 10) g (10 to 500) g 501 g to 20 kg (> 20 to 5000) kg	0.04 % + 0.6R 0.025 % + 0.6R 0.017 % + 0.6R 0.017 % + 0.6R	Class F weights (applied load)
	Up to 1000 lb (1000 to 120 000) lb	0.017 % + 0.6R 0.017 % per 1000 lb + 0.6R	Class F weights (applied load)
Check Weight Comparison ³ – Load Fixtures, Hangers, Package & Check Weights	Up to 4000 g	0.31 %	Scale w/ Class F weights
Force ³	Up to 1000 lbf	0.017 % + 0.6R	ASTM Class F weights
	Up to 500 lbf	0.43 lbf + 0.6R	500lb Load cell w/indicator
	Up to 2000 lbf	1.8 lbf + 0.6R	2K Load cell w/indicator
	Up to 5000 lbf	4.3 lbf + 0.6R	5K Load cell w/indicator
	Up to 20 000 lbf	17.1 lbf + 0.6R	20K Load cell w/ indicator
Torque Wrenches ³ – Click, Dial, Adjustable, Screwdriver	Up to 250 ft·lbf	0.65 %	CDI sure test
Rotary Torque Tools ³ – Pneumatic, DC, Pulse	(0 to 180) N·m	1.3 % Full Scale	Crane-Torque Star w/ rotary transducers
Torque Testers ³	Up to 250 ft · lbs	0.13 %	Standard weights and torque arm

Parameter/Equipment	Range	CMC ^{2, 6, 7} (±)	Comments
Atmospheric Pressure (Vacuum) ³	Up to 30 in·Hg	0.04 in·Hg	Fluke 700G
Pressure ³	(0 to 28) in H ₂ O (0 to 15) psig (0.01 to 300) psig (0 to 2400) psig (5 to 10 000) psig	0.03 % of full scale 0.07 % of full scale 0.07 % of full scale 0.07 % of full scale 0.13 %	Merriam M200LS Fluke 700G Beamex IPM20C Beamex EXT160 Ametek T-100/C dead weight tester
Speed ³ – Optic/Non-Contact: RPM Totalizer/Rate Meters Contact: RPM Totalizer/Rate Meters	(6 to 100 000) rpm (2 to 3300) fpm (6 to 20 000) rpm (2 to 3300) fpm	0.018 % 0.018 % 0.22 % 0.22 %	Monarch PLT200
Totalize Meters ³ – Distance Measure	Up to 1000 yds	0.64 %	Monartch PLT200

IV. Thermodynamics

Parameter/Equipment	Range	CMC ^{2, 7} (±)	Comments
Infrared Temperature Indicators ³ (Optical Pyrometers)	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
Temperature Measuring Equipment – Direct Method ³	(-25 to 150) °C (150 to 350) °C	0.08 °C 0.75 °C	Fluke 9142P w/ PRT Fluke 9009

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Relative Humidity ³	(10 to 90) % RH	1.6 % RH	Vaisala HMI-41 w/ HMP- 46
RTD ³ - Simulation Pt 385, 100 Ω	(-200 to 0) °C (0 to 400) °C (400 to 800) °C	0.13 °C 0.25 °C 0.49 °C	Beamex MC2-MF
Measure Pt 385, 100 Ω	(-200 to 0) °C (0 to 400) °C (400 to 800) °C	0.37 °C 0.61 °C 0.97 °C	
Temperature – Measure ³	(-196 to 420) °C (350 to 800) °C (800 to 1450) °C	0.08 °C 1.6 °C 2.4 °C	9142P w/ PRT Fluke 724 w/ 5650-20 Type S Probe
Thermocouple Simulation ³ –			
Type B	(600 to 800) (800 to 1820)	0.58 °C 0.47 °C	Fluke 5500A
Type E	(-250 to -100) (-100 to 650) (650 to 1000)	0.64 °C 0.38 °C 0.34 °C	
Type J	(-210 to -100) (-100 to 760) (760 to 1200)	0.4 °C 0.31 °C 0.36 °C	
Type K	(-200 to -100) (-100 to 1000) (1000 to 1372)	0.46 °C 0.39 °C 0.53 °C	
Type R	(0 to 250) (250 to 1000) (1000 to 1767)	0.72 °C 0.48 °C 0.53 °C	
Type S	(0 to 250) (250 to 1400) (1400 to 1767)	0.61 °C 0.5 °C 0.6 °C	
Type T	(-250 to -150) (-150 to 0) (0 to 400)	0.79 °C 0.37 °C 0.3 °C	

V. Time & Frequency

Parameter/Equipment	Range	CMC ^{2, 5, 7} (\pm)	Comments
Timers & Stopwatches ³	(1 to 3600) s	0.2 s	Monarch tachometer and timer
	(3600 to 86 400) s	$(2 + 0.0001T) s + 0.6R$	24 hour traceable Stopwatch

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 measurands stated are generated using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure the measurand in the ranges indicated. CMCs are expressed as either a specific value that covers the full range or as a fraction/percentage of the reading plus a fixed floor specification.

⁵ The statement of the CMC, L is the numerical value of the nominal length of the device measured in inches, and R is the numerical value of the resolution of the device in micro inches, T is the numerical value of the nominal time in seconds. In the statement of the CMC or Range, DL is the length of the diagonal in inches.

⁶ Unless otherwise noted, percentage refers to percent of reading.

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 & COMPANY, LLC

Charlotte, NC

for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *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 13th day of July 2017.

A handwritten signature in black ink, written over a horizontal line.

President and CEO
For the Accreditation Council
Certificate Number 1741.11
Valid to August 31, 2019
Revised January 4, 2019

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