



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

WESTERN STATES CALIBRATION
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CALIBRATION

Valid To: February 29, 2020

Certificate Number: 2904.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations¹:

I. Dimensional

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Calipers ³	Up to 6 in (6 to 72) in	440 μin (400 + 9.3L) μin	Gage blocks
Cylindrical Ring Gages	(0.04 to 14) in	(6.4 + 12L) μin	Pratt & Whitney Labmaster™, gage blocks, ring gages
Dial Indicators ³	Up to 1 in: 0.0005 in resolution 0.001 in resolution	340 μin 660 μin	Indicator tester
Test Indicators ³	Up to 0.050 in: 0.000 02 in resolution 0.000 05 in resolution 0.0001 in resolution	14 μin 48 μin 74 μin	Gage blocks
Gage Blocks	Up to 4 in	(3.4 + 2L) μin	Federal gage block comparator

Parameter/Equipment	Range	CMC ^{2,4} (\pm)	Comments
Indicator Tester	Up to 1 in: 0.0001 in resolution	84 μ in	Gage blocks, amplifier, lever gage head, surface plate
	Up to 0.05 in: 0.000 01 in resolution	18 μ in	
Height Masters	Up to 24 in	8.4 μ in/in + 41 μ in	Gage blocks, amplifier, lever gage head, surface plate
Height Gages ³	Up to 24 in: 0.001 in resolution 0.0001 in resolution	650 μ in 260 μ in	Gage blocks, surface plates
Linear Measurements – Outside	(0.05 to 13) in	(3.9 + 7.2L) μ in	Pratt & Whitney Labmaster™, gage blocks, Pratt & Whitney UMM
	(13 to 48) in	(7 + 19L) μ in	
Three Dimensional – Length	Dimension 1	Up to 23.5 in	OGP Flash 500
	Dimension 2	Up to 23.5 in	
	Dimension 3	Up to 4 in	
Micrometers ³ –	Outside Diameter	Up to 6 in (6 to 36) in	Gage blocks, optical flat
	Inside Diameter	Up to 48 in	
	Hole Micrometer	Up to 4 in	Ring gages

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Micrometers ³ – (cont)			
Depth	Up to 12 in	(66 + 7L) μin	Gage blocks, optical flat, surface plate
Anvil / Spindle Flatness	Up to 1 in	8 μin	Optical parallels
Pin/Plug Gages	Up to 1 in	21 μin	Pratt & Whitney Labmaster TM , gage blocks
Thread Plug Gage, Plain & Truncated –			
Major Diameter	Up to 1.5 in / (4 to 80) TPI (1.5 to 4) in / (4 to 80) TPI	27 μin 29 μin	Pratt & Whitney Supermike TM , thread wires
Pitch Diameter	Up to 4 in / (4 to 80) TPI	100 μin	
Thread Rings	Up to 2 in	360 μin	Thread setting plugs
Thread Wires	(4 to 80) TPI	14 μin	Pratt & Whitney Labmaster TM
Surface Plates ³	Up to 200 in Diagonal Repeat Reading	32 μin	Repeat-o-meter
	Up to 34 in Diagonal Flatness	70 μin	
	(34 to 200) in Diagonal Flatness	12 √DL	Electronic levels

II. Electrical – DC/Low Frequency

Parameter/Range	Frequency	CMC ^{2, 6} (±)	Comments
AC Current – Generate			
(32 to 330) µA	(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	0.23 % + 130 nA 0.18 % + 120 nA 0.15 % + 130 nA 0.38 % + 180 nA 0.93 % + 250 nA 1.9 % + 550 nA	Fluke 5520A
(0.33 to 3.3) mA	(10 to 20) Hz (20 to 1) kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.04 % + 25 µA 0.04 % + 17 µA 0.07 % + 17 µA 0.27 % + 18 µA 0.04 % + 17 µA	
(3.3 to 33) mA	(10 to 20) Hz (20 to 1) kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.04 % + 25 µA 0.04 % + 17 µA 0.07 % + 17 µA 0.27 % + 18 µA 0.04 % + 18 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	0.21 % + 33 µA 0.11 % + 37 µA 0.05 % + 29 µA 0.11 % + 110 µA 0.23 % + 130 µA 0.47 % + 260 µA	
(0.33 to 1.1) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.21 % + 150 µA 0.06 % + 150 µA 0.69 % + 1.3 mA 2.9 % + 6.6 mA	
(1.1 to 3) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.21 % + 0.30 mA 0.02 % + 6.9 mA 0.05 % + 1.3 mA 2.9 % + 7.8 mA	
(3 to 11) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz	0.07 % + 3.5 mA 0.13 % + 2.4 mA 3.6 % + 5 mA	
(11 to 21) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.07 % + 48 mA 0.16 % + 11 mA 3.4 % + 30 mA	

Parameter/Range	Frequency	CMC ^{2, 6, 7} (±)	Comments
AC Current – Measure			
(29 to 199.99) μA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.025 % + 24 nA 0.017 % + 60 nA 0.041 % + 13 nA 0.23 % + 16 nA	Fluke 8508A
(0.2 to 1.9999) mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	22 μA/A + 770 nA 0.025 % + 360 nA 0.029 % + 660 nA 0.23 % + 390 nA	
(2 to 19.999) mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	88 μA 0.016 % + 2 μA 0.041 % + 2 μA 0.23 % + 2 μA	
(20 to 199.99) mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz	900 μA 0.017 % + 12 μA 0.031 % + 27 μA	
(0.2 to 1.9999) A	10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz	0.036 % + 180 μA 0.040 % + 190 μA 0.18 % + 110 μA	
(2 to 19.999) A	10 Hz to 2 kHz (2 to 10) kHz	0.053 % + 960 μA 0.15 % + 2 mA	
AC Voltage – Generate			
(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	0.041 % + 45 μV 63 μV/V + 24 μV 32 μV/V + 42 μV 0.11 % + 14 μV 0.37 % + 29 μV 0.9 % + 77 μV	Fluke 5520A
(33 to 330) mV	(10 to 45) Hz 45 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.011 % + 45 μV 0.017 % + 13 μV 0.042 % + 14 μV 0.094 % + 40 μV 0.23 % + 110 μV	

Parameter/Range	Frequency	CMC ^{2,6} (±)	Comments
AC Voltage – Generate (cont)			
(0.33 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	0.03 % + 420 μV 0.02 % + 95 μV 0.03 % + 89 μV 0.04 % + 120 μV 0.09 % + 200 μV 0.01 % + 1.1 mV	Fluke 5520A
(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	0.03 % + 4.2 mV 0.02 % + 1 mV 0.03 % + 900 μV 0.04 % + 4 mV 0.2 % + 3.8 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	0.03 % + 7.2 mV 0.03 % + 11 mV 0.04 % + 10 mV 0.04 % + 26 mV 0.22 % + 110 mV	
(330 to 1020) V	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.04 % + 55 mV 0.03 % + 30 mV 0.04 % + 30 mV	

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments
AC Voltage – Measure			
(0.2 to 1.9999) V	(40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	53 μV/V + 21 μV 15 μV/V + 200 μV 22 μV/V + 200 μV 0.013 % + 29 μV 0.033 % + 130 μV 0.18 % + 2 mV 0.58 % + 13 mV	Fluke 8508A
(2 to 19.999) V	(40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	58 μV/V + 120 μV 56 μV/V + 140 μV 64 μV/V + 200 μV 0.013 % + 260 μV 0.033 % + 2 mV 0.18 % + 13 mV 0.5 % + 160 mV	
(20 to 199.99) V	(40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	55 μV/V + 2 mV 22 μV/V + 10 mV 66 μV/V + 2 mV 0.013 % + 3 mV 0.034 % + 12 mV 0.18 % + 130 mV 0.58 % + 2 V	
(200 to 1050) V	40 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	64 μV/V + 17 mV 0.013 % + 27 mV 0.033 % + 140 mV	

Parameter/Equipment	Range	CMC ^{2, 6, 7} (±)	Comments
DC Current – Generate	(0 to 329.999) μ A (0 to 3.299 99) mA (0 to 32.9999) mA (0 to 329.999) mA (0 to 1.099 99) A (1.1 to 2.999 99) A (0 to 10.0000) A (11 to 20.5) A	0.010 % + 77 nA 63 μ A 170 μ A 31 μ A/A + 130 μ A 12 mA 130 mA 130 mA 130 mA	Fluke 5520A
DC Current – Measure	(0 to 199.990 00) μ A (0.2 to 1.9999) mA (2 to 19.999) mA (20 to 199.99) mA (0.2 to 1.9999) A (2 to 19.999) A	2 μ A/A + 6 nA 6 μ A/A + 8 nA 5 μ A/A + 160 μ A 28 μ A/A + 1 μ A 0.02 % + 18 μ A 0.03 % + 230 μ A	Fluke 8508A
DC Voltage – Generate	(0 to 329.9999) mV (0 to 3.299 999) V (0 to 32.999 99) V (30 to 329.9999) V (100 to 1000.000) V	32 μ V 8.2 μ V/V + 21 μ V 12 μ V/V + 110 μ V 0.01 μ V/V + 2 mV 0.54 μ V/V + 5.2 mV	Fluke 5520A
DC Voltage – Measure	(0.0001 to 199.990 00) mV (0.2 to 1.9999) V (2 to 19.999) V (20 to 199.99) V (200 to 1050.00) V	3 μ V/V + 190 nV 2 μ V/V + 2 μ V 1 μ V/V + 180 μ V 4 μ V/V + 33 μ V 4 μ V/V + 420 μ V	Fluke 8508A
Resistance – Generate	(0 to 10.9999) Ω (11 to 32.999) Ω (33 to 109.9999) Ω (110 to 329.9999) Ω 330 Ω to 1.099 999 k Ω (1.1 to 3.299 999) k Ω (3.3 to 10.999 99) k Ω (11 to 32.999 99) k Ω (33 to 109.9999) k Ω (110 to 329.9999) k Ω	37 $\mu\Omega/\Omega$ + 0.0017 Ω 32 $\mu\Omega/\Omega$ + 0.0023 Ω 30 $\mu\Omega/\Omega$ + 0.0022 Ω 34 $\mu\Omega/\Omega$ + 0.0031 Ω 32 $\mu\Omega/\Omega$ + 0.0048 Ω 19 $\mu\Omega/\Omega$ + 0.12 Ω 30 $\mu\Omega/\Omega$ + 0.072 Ω 42 $\mu\Omega/\Omega$ + 0.035 Ω 19 Ω 36 $\mu\Omega/\Omega$ + 3.2 Ω	Fluke 5520A

Parameter/Equipment	Range	CMC ^{2, 5, 6, 7} (\pm)	Comments
Resistance – Generate (cont)	330 k Ω to 1.099 999 M Ω (1.1 to 3.299 999) M Ω (3.3 to 10.999 99) M Ω (11 to 32.999 99) M Ω (33 to 109.9999) M Ω (110 to 329.9999) M Ω (330 to 1100) M Ω	13 $\mu\Omega/\Omega$ + 68 Ω 60 $\mu\Omega/\Omega$ + 85 Ω 0.011 % + 960 Ω 0.03 % + 4.3 k Ω 0.01 % + 18 k Ω 0.36 % + 130 k Ω 1.8 % + 580 k Ω	Fluke 5520A
Resistance – Measure	(0 to 1.9999) Ω (2 to 19.999) Ω (20 to 199.99) Ω 200 Ω to 1.9999 k Ω (2 to 19.999) k Ω (20 to 199.99) k Ω 200 k Ω to 1.9999 M Ω (2 to 19.999) M Ω (20 to 199.99) M Ω 200 M Ω to 1.9999 G Ω	5 $\mu\Omega/\Omega$ + 24 $\mu\Omega$ 2 $\mu\Omega/\Omega$ + 280 $\mu\Omega$ 2 $\mu\Omega/\Omega$ + 2 m Ω 40 $\mu\Omega/\Omega$ + 3 m Ω 3 $\mu\Omega/\Omega$ + 110 m Ω 3 $\mu\Omega/\Omega$ + 83 m Ω 1 $\mu\Omega/\Omega$ + 16 Ω 6 $\mu\Omega/\Omega$ + 380 Ω 250 k Ω 0.061 % + 2 M Ω	Fluke 8508A
Capacitance – Generate	(1.1 to 3.2999) nF (3.3 to 10.999) nF (11 to 32.999) nF (33 to 109.999) nF (110 to 229.999) nF (0.3 to 1.0999) μ F (1.1 to 10.9999) μ F	0.39 % + 0.04 nF 0.22 % + 0.04 nF 0.23 % + 0.18 nF 0.29 % + 0.17 nF 0.2 % + 1.2 nF 0.29 % + 1.6 nF 0.2 % + 12 nF	Fluke 5520A
Electrical Simulation of Thermocouples ³ –			
Type E	(-250 to -100) $^{\circ}$ C (-100 to -25) $^{\circ}$ C (-25 to 350) $^{\circ}$ C (350 to 650) $^{\circ}$ C (650 to 1000) $^{\circ}$ C	0.85 $^{\circ}$ C 0.64 $^{\circ}$ C 0.01 % + 0.52 $^{\circ}$ C 0.01 % + 0.61 $^{\circ}$ C 0.01 % + 0.55 $^{\circ}$ C	Fluke 5520A
Type J	(-210 to -100) $^{\circ}$ C (-100 to -30) $^{\circ}$ C (-30 to 760) $^{\circ}$ C	1.1 $^{\circ}$ C 0.48 $^{\circ}$ C 0.12 $^{\circ}$ C	
Type K	(-200 to -100) $^{\circ}$ C (-100 to 120) $^{\circ}$ C (120 to 1000) $^{\circ}$ C (1000 to 1372) $^{\circ}$ C	0.33 $^{\circ}$ C 0.31 $^{\circ}$ C 0.32 $^{\circ}$ C 0.31 $^{\circ}$ C	

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Electrical Simulation of Thermocouples – (cont)			
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.01 % + 0.31 °C 0.32 °C 0.01 % + 0.22 °C 0.01 % + 0.22 °C	Fluke 5520A
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.01 % + 0.31 °C 0.32 °C 0.23 °C 0.01 % + 0.17 °C	
Type T	(-250 to 120) °C (120 to 400) °C	0.11 °C 0.01 % + 0.11 °C	

III. Mechanical

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Force – Measuring Equipment ³	(0 to 300) lbf	0.032 % + 0.0008 lbf	Class F weights, class S-1 weights
	(100 to 25 000) lbf	0.025 % + 2.7 lbf	Load cells
Vacuum	(0 to 29.5) inHg	0.14 inHg	Mensor DPG2300
Gage Pressure – Measuring Equipment ³	(0 to 3) psi (3 to 50) psi (50 to 10 000) psi	0.037 psi 0.08 % 0.02 %	Pressurements limited W2200-3-P dead weight tester

Parameter/Equipment	Range	CMC ^{2, 5} (±)	Comments
Indirect Verification of Hardness Testers ³	HRBW: (20 to 30) HRBW (35 to 55) HRBW (59 to 65) HRBW HRC: (20 to 30) HRC (35 to 55) HRC (59 to 65) HRC	0.76 HRBW 0.75 HRBW 0.69 HRBW 0.63 HRC 0.64 HRC 0.61 HRC	ASTM E18
Scales ³	(0 to 136) kg	0.032 % + 0.035 g	Class F weights, class S-1 weights
Mass	(4.54 to 22.7) kg	2.3 g	Class S1 weights
Torque – Measure	20 in·oz to 1000 ft·lbf	0.89 %	Digital torque load cells
Torque – Measuring Equipment	20 in·oz to 1000 ft·lbf	0.092 %	Calibration arms & weights

IV. Thermodynamics

Parameter/Equipment	Range	CMC ² (±)	Comments
Temperature – Measure ³	(-200 to 0) °C (0 to 100) °C (100 to 660) °C	0.37 °C 0.058 °C 0.063 °C	Hart Scientific black stack w/ 1925-A thermistor probe PRT

Parameter/Equipment	Range	CMC ² (±)	Comments
Temperature – Measuring Equipment ³	(-40 to 0) °C	0.37 °C	Hart Scientific black stack w/ 1925-A thermistor probe & temperature bath
	(0 to 100) °C	0.058 °C	
	(100 to 660) °C	0.075 °C	PRT & dry well
Infrared Thermometers	(35 to 500) °C	0.36 % + 0.33 °C	Fluke 4181 precision IR calibrator
Relative Humidity – Measuring Equipment ³	(10 to 80) % RH	0.77 % RH	Thunder Scientific 2500 humidity generator

V. Time & Frequency

Parameter/Equipment	Range	CMC ² (±)	Comments
Frequency Reference	10 MHz	0.67 Hz	GPS reference
Frequency – Measure	0.1 Hz to 225 MHz	0.68 Hz	GPS reference w/ HP 53132A

¹ This laboratory offers commercial 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, L is the numerical value of the nominal length of the device measured in inches; R is the numerical value of the resolution of unit under test; and DL is the diagonal length of the unit under test in inches.
- ⁵ In the statement of CMC, percentages are to be read as percent of reading, unless noted otherwise.
- ⁶ The measurands stated are generated with the Fluke 5520A series of instruments. This capability is suitable for the calibration of the devices intended to measure the stated measurand in the ranges indicated. CMCs are expressed as either a specific value that covers the full range or as a fraction of the reading plus a fixed floor specification.
- ⁷ The measurands stated are measured with the Fluke 8508A. This capability is suitable for the calibration of the devices intended to generate the measurand in the ranges indicated. CMCs are expressed as either a specific value that covers the full range or as a combination of the fraction of the reading/output plus a range specification.



Accredited Laboratory

A2LA has accredited

WESTERN STATES CALIBRATION

Salt Lake City, UT

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 the requirements of ANSI/NCSLI Z540-1-1994 and 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 8 January 2009).



Presented this 2nd day of February 2018.

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

President and CEO
For the Accreditation Council
Certificate Number 2904.01
Valid to February 29, 2020

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