SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017
& ANSI/NCSL Z540-1-1994

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CALIBRATION

Valid To: February 28, 2025 Certificate Number: 0723.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations[1, 10]:

I. Acoustical Quantities

Parameter/Range	Frequency	CMC[2, 6] (±)	Comments
Sound Level – Measuring Equipment[3]			
(94, 104, 114) dB	(31.5, 63, 125) Hz (250, 500) Hz (1, 2, 4, 8) kHz (12.5, 16) kHz	0.3 dB 0.3 dB 0.3 dB 0.3 dB	Sound calibrator

II. Chemical

Parameter/Range	Range	CMC[2] (±)	Comments
pH Meters, Fixed Points	4 pH 7 pH 10 pH	0.02 pH 0.02 pH 0.02 pH	pH solutions
Conductivity Meters	10 µS/cm 100 µS/cm 1000 µS/cm 1483 µS/cm 10 000 µS/cm	0.25 µS/cm 0.26 µS/cm 2.6 µS/cm 3.6 µS/cm 26 µS/cm	Conductivity solutions

III. Dimensional

Parameter/Equipment	Range	CMC[2, 4, 8] (±)	Comments
Gage Blocks	(0.05 to 4) in (4 to 20) in	(2.8 + 1.0*L*) µin (5.7 + 1.0*L*) µin	Mechanical comparison (metric to 300 mm available)
Thread Wires	Up to 0.3 in – All Sizes English & Metric	4.6 µin	P & W LabMaster™ Universal
Protractors – Digital, Etched[3]	(0.25 to 90)º	0.3°	Gage blocks & sine bar
Surface Roughness[3]	Ra, Rq (2 to 1600) µin Rz, Ry (10 to 6400) µin	2.3 µin 2.3 µin	Surface tester
60º Thread Plugs –			
Pitch Diameter	(3 to 108) TPI	12 µin	P & W Labmaster™ & thread wires
Major Diameter	Up to 12 in	11 µin	
Pitch Diameter	(0.12 to 2) in	(20 + 1*L*) µin	IAC MasterScanner
Major Diameter	(0.12 to 2) in	(37 + 1*L*) µin	
Adjustable & Fixed Thread Rings[3]	Up to 12 in (0.12 to 2) in	Master Set plug "W" tolerance (37 + 1*L*) µin	Set using master plug gages. ASME/ANSI B1.2-1983 & ASME/B1.3-2007 IAC MasterScanner
Parallels –	Up to 48 in	(11 + 1*L*) µin	Gage amp w/ probe
Levels – Machinist[3]	Up to 96 in	11 µin/ft	Gage blocks

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
Micrometers – Head, Inside, Outside & Depth[3]	Up to 84 in	(34 + 1*L*) µin	Gage blocks
Calipers – Dial, Digital, Vernier & Gear Tooth Vernier[3]	Up to 84 in	(62 + 1*L*) µin	Gage blocks
Bore Gages & Micrometers[3] 2 Anvil 3 Anvil	 (0.125 to 20) in (0.06 to 7) in	 (62 + 1*L*) µin 70 µin	 Gage blocks Ring gages
Indicators – Dial, Digital & Test Travel[3]	Up to 12 in	89 µin	Indicator checker
Height Gages – Dial, Digital, Vernier & Digi-Chek[3]	Up to 72 in	(60 + 1.5*L*) µin	Gage blocks & surface plate
Thickness Gages[3]	(0.0001 to 1) in	(34 + 1*L*) µin	Gage blocks
Surface Plate – Flatness[3]	Up to 240 ft	1.4 µin/in	Renishaw XL-80 laser (standard 845A)
Angle Gage	Up to 5 in	0.1°	Optical comparator
Radius Gage	Up to 5 in	72 µin	Optical comparator
Length End Standards – Snap & Step Gages	Up to 12 in Up to 66 in	(6 + 1.0*L*) µin (14 + 2*L*) µin	P & W Labmaster™ Gage amp w/ probe
Plain Ring Gages	Up to 12 in	(3.2 + 0.70*L*) µin	P & W Labmaster™
Pin & Plug Gages	Up to 12 in	(3.2 + 0.70*L*) µin	P & W Labmaster™

Parameter/Equipment	Range[7]	CMC[2, 4] (±)	Comments
Coordinate Measuring Machine – Linear Axis Displacement (X, Y, Z)[3]	Up to 12 ft (3 to 240) ft	2.6*F* µin 70*F* µin	Renishaw XL-80 laser
Optical Comparator[3] – Linear Axis (X, Y) Angle Radius	 Up to 30 in (1 to 90)° (0.125 to 0.375) in	 0.0002 in 0.035° 860 µin	 Glass scales, glass reticle
Coating Thickness[3]	Up to 60 mil Up to 1500 mil	0.065 mil 0.11 mil	Thickness standard
Sine Bar/Plate – Angle Parallel	 Up to 12 in Up to 24 in	 23 µin (11 + 1*L*) µin	 Gage blocks, angle blocks, gage amp, surface plates
Squares	Up to 18 in	0.000 17 in	Checker, indicator
Tape Measure	Up to 100 ft	0.011 in	Gage blocks, optical comparator

IV. Dimensional Testing/Calibration[9]

Parameter/Range	Range	CMC[2, 4] (±)	Comments
Length – 1D	Up to 8 in (8 to 20) in 20 in to 16 ft	0.0003 in 10*L* µin 30*F* µin	Optical comparator Gage blocks Opto-Dyne laser

V. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC[2, 4, 5] (±)	Comments
DC Voltage – Measure & Generate[3]	(1 to 200) mV (0.2 to 2) V (2 to 20) V (20 to 200) V (200 to 1000) V	3.3 µV/V 3 µV/V 3 µV/V 4.4 µV/V 4.6 µV/V	Fluke 8508A
DC Voltage – Measure Only[3]	100 V to 2 kV (2 to 20) kV (1 to 10) kV (1 to 35) kV (1 to 100) kV	0.03 % + 20 mV 0.03 % 0.04 % 0.04 % 0.04 %	Vitrek 4620B Vitrek 4700B Vitrek 4700B w/35kV probe Vitrek 4700B w/100kV probe
DC Voltage – Generate, Fixed Point	10 V	0.42 µV/V	Fluke 732B
DC Current – Measure & Generate[3]	(1 to 200) µA 200 µA to 2 mA (2 to 20) mA (20 to 200) mA 200 mA to 2 A (2 to 20) A	4.1 µA/A 3.9 µA/A 3.3 µA/A 9.0 µA/A 11 µA/A 80 µA/A	Fluke 8508A
High Current	(10 to 1025) A (0 to 3000) A	0.04 A/A 0.04 A/A	Fluke 5522A w/ Fluke 50-turn coil 52120 Fluke amplifier w/ Fluke 25-turn coil
DC Current – Measure & Generate[3]	(1 to 100) mA 100 mA to 100 A	3.9 µA/A 57 µA/A	Fluke 8508A & standard resistors

Parameter/Equipment	Range	CMC[2, 4, 5] (±)	Comments
Resistance – Measure & Generate[3]	Up to 2 Ω (2 to 20) Ω (20 to 200) Ω 200 Ω to 2 kΩ (2 to 20) kΩ (20 to 200) kΩ 200 kΩ to 2 MΩ (2 to 20) MΩ (20 to 200) MΩ 200 MΩ to 2 GΩ (2 to 20) GΩ	12 μΩ/Ω + 4 μΩ 9.0 μΩ/Ω + 14 μΩ 7.8 μΩ/Ω + 50 μΩ 7.8 μΩ/Ω + 0.5 mΩ 7.8 μΩ/Ω + 5 mΩ 7.8 μΩ/Ω + 50 mΩ 8.0 μΩ/Ω + 1 Ω 15 μΩ/Ω + 100 Ω 60 μΩ/Ω + 10 kΩ 75 μΩ/Ω + 100 kΩ 100 μΩ/Ω + 10 MΩ	Fluke 8508A & standard resistors HV mode
Resistance – Measure & Generate, Fixed Points	0.001 Ω 0.01 Ω 0.1 Ω 1 Ω 1 kΩ 10 kΩ	55 μΩ/Ω 48 μΩ/Ω 14 μΩ/Ω 1.0 μΩ/Ω 0.8 μΩ/Ω 0.8 μΩ/Ω	Standard resistor comparison ESI SR 104 & Fluke 8508A
Oscilloscopes[3] – Gain – 1 MΩ 50 Ω Ground Flatness @ 50 Ω Fast Edge – Bandwidth/Rise & Fall Times Time Markers	 (36 to 999.9) μV (1 to 21) mV (21 to 556) mV 556 mV to 210 V (36 to 999.99) μV (1 to 21) mV (21 to 556) mV (0.556 to 5.56) V 0 V 0.1 Hz to 3.2 GHz 150 ps 450 ps to 55 s	 1.2 % + 15 μV 0.6 % + 15 μV 1.2 % + 1 μV 1.2 % + 1 μV 1.2 % + 10 μV 0.6 % + 15 μV 1.2 % + 1 μV 0.98 % + 15 μV 11 μV 1.3 % 0.8 + 5/-0 ps 12×10^{-6}	 Wavetek 9500 w/ 9530

Parameter/Equipment	Range	CMC[2, 5] (±)	Comments
Inductance – Generate & Measure[3]	50 µH to 1 H	0.003 mH	GenRad 1693 w/ standard inductors
Electrical Simulation of Thermocouple Indicators[3] –			
Type E	(-250 to -100) ºC (-100 to -25) ºC (-25 to 350) ºC (350 to 650) ºC (650 to 1000) ºC	0.51 °C 0.16 °C 0.14 °C 0.16 °C 0.21 °C	Fluke 5522A
Type J	(-210 to -100) ºC (-100 to -30) ºC (-30 to 150) ºC (150 to 760) ºC (760 to 1200) ºC	0.27 °C 0.16 °C 0.14 °C 0.17 °C 0.23 °C	
Type K	(-200 to -100) ºC (-100 to -25) ºC (-25 to 120) ºC (120 to 1000) ºC (1000 to 1372) ºC	0.34 °C 0.18 °C 0.16 °C 0.26 °C 0.4 °C	
Type R	(0 to 250) ºC (250 to 400) ºC (400 to 1000) ºC (1000 to 1767) ºC	0.48 ºC 0.37 ºC 0.38 ºC 0.47 ºC	
Type S	(0 to 250) ºC (250 to 1000) ºC (1000 to 1400) ºC (1400 to 1767) ºC	0.48 ºC 0.37 ºC 0.38 ºC 0.47 ºC	
Type T	(-250 to -150) ºC (-150 to 0) ºC (0 to 120) ºC (120 to 400) ºC	0.64 ºC 0.25 ºC 0.16 ºC 0.14 ºC	

Parameter/Range	Frequency	CMC[2, 4, 5] (±)	Comments
Capacitance – Measure & Generate[3]			
(0.2 to 200) pF	1 kHz	0.013 %	Gen Rad 1693 w/ standard capacitors
200 pF to 1 nF	1 kHz	0.07 %	
1 nF to 10 µF	1 kHz	0.065 %	
(10 to 100) µF	1 kHz	0.077 %	
(0.1 to 1) mF	100 Hz	0.17 %	
(1 to 10) mF	12 Hz	0.29 %	
AC Voltage – Measure[3]			
1 V to 2 kV	60 Hz	0.03 % + 0.1 V	Vitrek 4620B
1 V to 20 kV	60 Hz	0.04 % + 0.1 V	
(1 to 35) kV	60 Hz	0.14 %	Vitrek 4700B w/35kV probe
(30 to 100) kV	60 Hz	0.14 %	Vitrek 4700B w/100kV probe
AC Voltage – Measure & Generate[3]			
(0.2 to 200) mV	(1 to 10) Hz	170 µV/V	Fluke 8508A
	(10 to 40) Hz	130 µV/V	
	(40 to 100) Hz	110 µV/V	
	100 Hz to 2 kHz	100 µV/V	
	(2 to 10) kHz	110 µV/V	
	(10 to 30) kHz	310 µV/V	
	(30 to 100) kHz	760 µV/V	
(0.2 to 200) V	(1 to 10) Hz	170 µV/V	
	(10 to 40) Hz	130 µV/V	
	(40 to 100) Hz	110 µV/V	
	100 Hz to 2 kHz	100 µV/V	
	(2 to 10) kHz	110 µV/V	
	(10 to 30) kHz	310 µV/V	
	(30 to 100) kHz	760 µV/V	
(200 to 1000) V	(1 to 10) Hz	150 µV/V	
	(10 to 40) Hz	110 µV/V	
	40 Hz to 10 kHz	91 µV/V	
	(10 to 30) kHz	230 µV/V	
	(30 to 100) kHz	670 µV/V	

Parameter/Range	Frequency	CMC[2, 5] (±)	Comments
AC Current – Measure & Generate[3]			
200 µA to 20 mA	1 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	330 µA/A* 650 µA/A 3200 µA/A	Fluke 8508A *Generate functions are limited to starting frequency of 10 Hz from 200 µA to 200 mA
(20 to 200) mA	1 Hz to 10 kHz (10 to 30) kHz	330 µA/A* 650 µA/A	
200 mA to 2 A	10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz	650 µA/A 720 µA/A 2500 µA/A	
(2 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	800 µA/A 2100 µA/A	
High Current:			
(10 to 1025) A	(45 to 65) Hz	(0.5 + 0.051) Hz	Fluke 5500A w/ Fluke 50-turn coil
(0 to 3000) A	(10 to 65) Hz	(0.01 + 0.08) Hz	52120 Fluke amplifier w/ Fluke 25-turn coil
AC Power – Measure			
(0.01 to 5) kW	60 Hz	(2.7 + 0.007W)/pW	Fluke 8508, shunts

VI. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC[2, 4, 5] (±)	Comments
Attenuation – Measure[3]			
(0 to -100) dBm	0.1 MHz to 1.3 GHz	0.091 dB	HP 8902A & HP 8482A
Power – Measure[3]			
(-70 to +20) dBm	10 MHz to 26 GHz	0.87 %	HP 437B & HP 8485A

Parameter/Range	Frequency	CMC[2, 4, 5] (±)	Comments
Amplitude Modulation – Measure[3] Rate Frequency: 50 Hz to 10 KHz Depth: (5 to 99) %	 150 kHz to 10 MHz 10 MHz to 1.3 GHz	 1.4 % 1.4 %	 HP 8902A
Frequency Modulation – Measure[3] Rate Frequency: 20 Hz to 10 kHz ≤ 40 kHz_{peak} 50 Hz to 100 kHz ≤ 400 kHz_{peak}	 250 kHz to 10 MHz 10 MHz to 1.3 GHz	 0.073 % 0.086 %	 HP 8902A

VII. Fluid Quantities

Parameter/Range	Range	CMC[2, 4] (±)	Comments
Pipettes	(0.2 to 1) µl (1 to 5) µl (5 to 10) µl (10 to 100) µl 100 µl to 10 ml	0.003 µl 0.007 µl 0.007 µl 0.007 µl 0.007 µl	Gravimetric method using analytical balances
Volumetric Dispensers/Burettes	(10 to 100) ml	0.06 µl	Gravimetric method using analytical balances
Anemometer – Air Flow	(25 to 1500) FPM (> 1500 to 10 000) FPM	(0.6 + 2 %) FPM (18 + 1 %) FPM	Omega WT4401-D

VIII. Mechanical

Parameter/Equipment	Range[7]	CMC[2, 6] (±)	Comments
Force – Measure[3]			
Compression & Tension	Up to 500 lbf Up to 2000 lbf Up to 25 000 lbf Up to 60 000 lbf	0.02 lbf 0.031 lbf 0.41 lbf 1.1 lbf	Load cell systems
Compression Only	(20 000 to 300 000) lbf	(16 + 2/klbf) lbf	
Force – Measuring Equipment[3]	Up to 1000 lbf	0.02 % of range	NIST Class F weights
Scales & Balances[3]	(1 to 50) mg 50 mg to 2 g (3 to 50) g 500 g to 1 kg 100 g 200 g 2 kg 5 kg 10 kg	1.6 µg 2.9 µg 4.9 µg 1.2 mg 23 µg 46 µg 1.4 mg 1.6 mg 2.2 mg	ASTM Class 0 & 1 weights, NIST Class F weights
Mass – Measure	(10 to 50) g (1 to 2) kg (2 to 6.1) kg (6.1 to 31) kg	12 µg 1.6 mg 0.84 mg 9.5 mg	Electronic microbalance & ASTM Class 0 & 1 weight sets
Fixed Points	1 mg 500 mg 1 g 5 g 100 g 200 g 500 g	1.7 µg 2.2 µg 3.0 µg 5.0 µg 840 µg 870 µg 1.6 mg	Electronic balance & ASTM Class 0 & 1 weight sets

Parameter/Equipment	Range[7]	CMC[2, 4, 6] (±)	Comments
Indirect Verification of Rockwell Hardness Testers[3]	HRBW: Medium High HRC: Low Medium High	 1.2 HRB 1.2 HRB 1.0 HRC 1.0 HRC 1.0 HRC	Indirect verification per procedure DCN 500945 using hardness blocks
Torque – Measure[3]	0.02 ozf·in to 100 lbf·in 1 ozf·in to 2000 lbf·ft	0.23 % 0.27 %	Torque calibrators
Torque – Measuring Equipment[3]	(0.125 to 50) ozf·in (0.25 to 250) lbf·ft (250 to 2000) lbf·ft	0.15 % 0.068 % 0.068 %	Arms & weights
Pressure – Measure & Measuring Equipment[3]	(-29 to 0) in·Hg (0 to 30) psia (5 to 40) in·H_2O (0.5 to 600) psig (3 to 18 000) psig (Up to 750) psig (750 to 6000) psig	0.005 in·Hg (0.075 + 1.7 %) psia 0.04 % 0.016 % 0.035 % 0.038 % 0.016 %	Transducer Pneumatic dead weight Hydraulic dead weight Mensor CPC 8000
Durometer – Spring Calibration Force Only[3]	Types: M OO, OOO A, B, E, O C, D, DO	 0.001 duro units 0.001 duro units 0.003 duro units 0.005 duro units	Note: this is a limited calibration of ASTM D2240
Tachometer	(10 to 50 000) RPM	0.002 RPM	Universal counter (HP 53131A/HP 53120A)

IX. Optical

Parameter/Range	Range	CMC[2, 4, 6] (±)	Comments
Light – Measure	(50 to 200) FC	1.5 %	STD lamp

X. Thermodynamics

Parameter/Equipment	Range	CMC[2, 6] (±)	Comments
Temperature – Measure[3]	(-100 to 660) ºC (100 to 660) ºC (660 to 1450) ºC	0.005 ºC 0.009 ºC 0.6 ºC	SPRT & meter Type S T/C & meter
Temperature – Measuring Equipment[3]	(-30 to 250) ºC (250 to 400) ºC (400 to 650) ºC	0.093 ºC 0.085 ºC 0.42 ºC	SPRT & bath SPRT & dry blocks & dry wells
Infrared Thermometers	(-30 to 500) ºC	(0.092 + 0.000 32/ºC) ºC	Infrared calibrator monitored w/ digital thermometer & SPRT $\varepsilon = 0.95$, λ= (8 to 14) mm
Relative Humidity – Measure[3]	(10 to 90) % RH	1.2 % RH	Digital hygrometer
Relative Humidity – Measuring Equipment	(10 to 90) % RH	0.2 % RH	Dual pressure humidity chamber

XI. Time & Frequency

Parameter/Range	Frequency	CMC[2, 6] (±)	Comments
Frequency – Measuring Equipment	Up to 20 GHz	17 pHz/Hz	Frequency generators & MicroSemi Xli 1510-602 GPS receiver
Frequency – Measure	Up to 26.5 GHz	40 pHz/Hz	Frequency counter & MicroSemi Xli 1510-602 GPS receiver

[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. 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 nominal length in inches; R is the resolution in inches for dimensional calibrations or the resolution of the unit under test for balances and scales; F is the nominal length in feet; percentages are to be read as the percentage 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] Where ranges are not specified, the CMC stated is for the cardinal points only.

[8] As this involves a functional check that may include an adjustment, this is not considered a calibration and therefore the CMC value is not applicable (N/A). Adjustable thread rings are set to applicable specification using calibrated master plug gages.

[9] This laboratory meets R205 – *Specific Requirements: Calibration Laboratory Accreditation Program* for the types of dimensional tests listed above and is considered equivalent to that of a calibration.

[10] This scope meets A2LA's *P112 Flexible Scope Policy*.

Accredited Laboratory

A2LA has accredited

JJ CALIBRATIONS, INC.

Portland, OR

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 ANSI/NCSL 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 April 2017*).

Presented this 17th day of January 2023.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 0723.01
Valid to February 28, 2025
Revised January 22, 2025

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