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

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CALIBRATION

Valid To: November 30, 2020 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, 11] (±)	Comments
Sound Level[3] – Measuring Equipment			
(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 0.4 dB 0.6 dB	Sound calibrator

II. Dimensional

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
Gage Blocks	(0.05 to 4) in (4 to 20) in	(2.9 + 1.2*L*) µin (8.6 + 1.2*L*) µin	Mechanical comparison (metric to 300 mm available)
Thread Wires	All Sizes English and Metric up to 0.3 in	10 µin	P & W Labmaster™ universal
Protractors[3] – (Digital, Etched)	(0.25 to 90)º	0.0015°	Gage blocks and sine bar

Parameter/Equipment	Range	CMC[2, 4, 6] (±)	Comments
Surface Roughness[3]	Ra, Rq (2 to 1600) µin Rz, Ry (10 to 6400) µin	6 % + 3 µin 6 % + 3 µin	Surface tester
60º Thread Plugs – Pitch Diameter Major Diameter Pitch and Major Diameter	 (3 to 108) TPI Up to 12 in (0.12 to 2) in	 71 µin 31 µin (7 + 1*L*) µin	 P & W Labmaster™ and thread wires IAC Masterscanner
Adjustable and Fixed Thread Rings[3, 8]	Up to 12 in (0.12 to 2) in	Master Set plug "W" tolerance (7 + 1*L*) µin	Set using master plug gages. ASME/ANSI B1.2-1983 and ASME/B1.3-2007 IAC Masterscanner
Parallels – Steel Granite	 Up to 12 in Up to 24 in	 50 µin 100 µin	 Gage amp with probe
Levels[3] – Machinist	Up to 96 in	0.000 15 in/ft	Gage blocks
Micrometers[3] – (Head, Inside, Outside, Depth)	Up to 84 in	0.6*R* + 10*L* µin	Gage blocks
Calipers[3] – (Dial, Digital, Vernier, Gear Tooth Vernier)	Up to 84 in	0.6*R* + 10*L* µin	Gage blocks
Bore Micrometers[3]	Up to 6 in	0.6*R* + 10*L* µin	Gage blocks
Indicators[3] – (Dial, Digital, Test Travel)	Up to 12 in	0.6*R* + 10*L* µin	Gage blocks
Height Gages[3] – (Dial, Digital, Vernier, Digi-Chek)	Up to 48 in	0.6*R* + 10*L* µin	Gage blocks and surface plate

Parameter/Equipment	Range[7]	CMC[2, 4] (±)	Comments
Thickness Gages[3]	Up to 1 in	0.6*R* + 10*L* µin	Gage blocks
Surface Plate Flatness[3]	Up to 16 ft	30*F* µin	Opto-Dyne laser
Radius Gage	Up to 5 in	0.12°	Optical comparator
Length End Standards – Snap and Step Gages	Up to 12 in Up to 66 in	(6 + 1.0*L*) µin 55 µin	P & W Labmaster™ Gage amp w/ probe
Bore Gages[3] (3 points)	Up to 6 in	(0.6*R* + 30*L*) µin	Ring gages
Plain Ring Gages	Up to 12 in	(6 + 1.0*L*) µin	P & W Labmaster™
Pin and Plug Gages	Up to 12 in	(6 + 1.0*L*) µin	P & W Labmaster™
Coordinate Measuring Machine[3] – Linear Axis Displacement (X-Y-Z)	Up to 2400 in	20*F* µin	Opto-Dyne laser
Optical Comparator[3] – Linear Axis (X, Y) Angle Radius Circle	 Up to 30 in (0 to 90)° (0.125 to 0.375) in (0.005 to 0.0625) in	 0.0002 in 0.0002 in 0.0002 in 0.0002 in	Glass scales, glass reticle
Coating Thickness[3]	Up to 60 mil Up to 1500 mil	0.31 mil 0.5 mil	Thickness standard
Sine – Angle Parallel	 Up to 12 in Up to 24 in	 5” 100 µin	Gage blocks, angle blocks, gage amp, surface plates
Square	Up to 18 in	0.00017 in	Checker, indicator
Tape Measure	Up to 100 ft	0.005 in	Gage blocks, optical comparator

III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC[2, 5, 6] (±)	Comments
DC Voltage[3] – Measure and Generate	Up to 200 mV (0.2 to 2) V (2 to 20) V (20 to 200) V (200 to 1000) V	5 µV/V + 0.1 µV 3.5 µV/V + 0.4 µV 3.5 µV/V + 4 µV 5.5 µV/V + 40 µV 5.5 µV/V + 0.5 mV	Fluke 8508A
DC Voltage[3] – Measure Only	Up to 20 kV (20 to 70) kV	0.02 % 0.04 %	Vitrek 4620B Vitrek 4700B
DC Voltage – Generate, Fixed Point	10 V	0.42 µV/V	Fluke 732B
DC Current[3] – Measure and Generate	Up 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	12 µA/A + 400 pA 12 µA/A + 4 nA 13 µA/A + 40 nA 36 µA/A + 0.8 µA 0.017 % + 16 µA 0.038 % + 400 µA	Fluke 8508A
High Current	(100 to 3000) A	0.3 % + 0.5 mA	Fluke 5500A with Fluke 50-turn coil
DC Current[3] – Measure and Generate	Up to 100 mA 100 mA to 1A (1 to 10) A (10 to 100) A	7.8 µA/A + 100 nA 16 µA/A + 1 µA 51 µA/A + 10 µA 71 µA/A + 100 µA	Fluke 8508A and standard resistors
Capacitance[3] – Measure and Generate			
1 kHz 1 kHz 1 kHz 1 kHz 100 Hz 12 Hz	Up to 200 pF 200 pF to 1 nF 1 nF to 10 µF (10 to 100) µF (0.1 to 1) mF (1 to 10) mF	0.22 % 0.04 % 0.03 % 0.05 % 0.12 % 0.25 %	Gen Rad 1693 with standard capacitors

Parameter/Equipment	Range	CMC[2, 5, 6] (±)	Comments
Resistance[3] – Measure and Generate	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 M Ω to 2 GΩ (2 to 20) GΩ	15 μΩ/Ω + 4 μΩ 9 μΩ/Ω + 14 μΩ 7.5 μΩ/Ω + 50 μΩ 7.5 μΩ/Ω + 0.5 mΩ 7.5 μΩ/Ω + 5 mΩ 7.5 μΩ/Ω + 50 mΩ 8.5 μΩ/Ω + 1 Ω 15 μΩ/Ω + 100 Ω 60 μΩ/Ω + 10 kΩ 0.015 % + 100 kΩ 0.053 % + 10 MΩ	Fluke 8508A and standard resistors HV mode
Resistance – Measure and Generate	0.001 Ω 0.01 Ω 0.1 Ω 1 Ω 10 kΩ	80 μΩ/Ω 50 μΩ/Ω 20 μΩ/Ω 10 μΩ/Ω 0.8 μΩ/Ω	Standard resistor comparison ESI SR 104 and Fluke 8508A
Oscilloscopes[3] –			
Gain			
1 MΩ	(36 to 999.9) μV (21 to 556) mV 556 mV to 210 V	1.2 % + 15 μV 0.12 % + 1 μV 0.062 % + 1 μV	Wavetek 9500 with 9530
50 Ω	(36 to 999.99) μV (1 to 21) mV (21 to 556) mV (0.556 to 5.56) V	1.2 % + 10 μV 0.12 % + 15 μV 0.12 % + 1 μV 0.062 % + 15 μV	
Ground	0 V	18 μV	
Flatness @ 50 Ω	0.1 Hz to 300 MHz (300 to 550) MHz (0.55 to 1) GHz (1 to 3.2) GHz	2.3 % 3.3 % 4.3 % 4.9 %	
Fast Edge – Bandwidth/Rise and Fall Times	150 ps	30 + 5/-0 ps	
Time Markers	450 ps to 55 s	12×10^{-6} s	

Parameter/Equipment	Range	CMC[2, 6] (±)	Comments
Inductance[3] – Generate and Measure	50 µH to 1 H	0.25 %	GenRad 1693 with standard inductors
Electrical Simulation of PRT Indicators[3] –			
Pt 385, 100 Ω	(-200 to -80) ºC (-80 to 0) ºC (0 to 100) ºC (100 to 300) ºC (300 to 400) ºC (400 to 630) ºC (630 to 800) ºC	0.06 °C 0.06 °C 0.08 °C 0.1 °C 0.11 °C 0.13 °C 0.24 °C	Fluke 5522A
PtNi 385, 120 Ω	(-80 to 0) ºC (0 to 100) ºC (100 to 260) ºC	0.09 °C 0.09 °C 0.14 °C	
Pt 3926, 100 Ω	(-200 to -80) ºC (-80 to 0) ºC (0 to 100) ºC (100 to 300) ºC (300 to 400) ºC (400 to 630) ºC	0.06 °C 0.06 °C 0.08 °C 0.1 °C 0.11 °C 0.13 °C	
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	0.5 °C 0.16 °C 0.15 °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 0.15 °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	0.33 °C 0.18 °C 0.16 °C 0.26 °C 0.4 °C	

Parameter/Equipment	Range	CMC[2] (±)	Comments
Electrical Simulation of Thermocouple Indicators[3] – (cont)			
Type R	(0 to 250) ºC (250 to 400) ºC (400 to 1000) ºC (1000 to 1767) ºC	0.57 ºC 0.35 ºC 0.33 ºC 0.4 ºC	Fluke 5522A
Type S	(0 to 250) ºC (250 to 1000) ºC (1000 to 1400) ºC (1400 to 1767) ºC	0.47 ºC 0.36 ºC 0.37 ºC 0.46 ºC	
Type T	(-250 to -150) ºC (-150 to 0) ºC (0 to 120) ºC (120 to 400) ºC	0.63 ºC 0.24 ºC 0.16 ºC 0.15 ºC	

Parameter/Range	Frequency	CMC[2, 5, 6] (±)	Comments
AC Voltage[3] – Measure Only			
(1 to 20) kV	60 Hz	0.05 %	Vitrek 4620B
(20 to 70) kV	60 Hz	0.08 %	Vitrek 4670B
AC Voltage[3] – Measure and Generate			
Up to 200 mV	10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.015 % + 4 µV 0.035 % + 4 µV 0.08 % + 20 µV	Fluke 8508A
(0.2 to 200) V	10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.012 % + 2 mV 0.023 % + 4 mV 0.06 % + 20 mV	
(200 to 1000) V	10 Hz to 10 kHz	0.015 % + 20 mV*	*Above 300 V, add: 0.000 04×(reading - 300)^2 µV/V

Parameter/Range	Frequency	CMC[2, 5, 6] (±)	Comments
AC Current[3] – Measure and Generate			
200 µA to 20 mA	1 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.029 % + 2 µA 0.065 % + 2 µA 0.4 % + 2 µA	Fluke 8508A
(20 to 200) mA	1 Hz to 10 kHz (10 to 30) kHz	0.029 % + 20 µA 0.06 % + 20 µA	
200 mA to 2 A	10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz	0.06 % + 200 µA 0.07 % + 200 µA 0.3 % + 200 µA	
(2 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	0.08 % + 2 mA 0.025 % + 2 mA	
High Current			
(100 to 3000) A	(45 to 65) Hz	0.35 % + 3 mA	Fluke 5500A with Fluke 50-turn coil

IV. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC[2, 6] (±)	Comments
Attenuation[3] –			
(0 to -100) dBm	0.1 MHz to 1.3 GHz	0.08 dB	HP 8902A and HP 8482A
Power[3] – Measure			
(-70 to +20) dBm	10 MHz to 26 GHz	3.8 %	HP 437B and HP 8485A
Amplitude Modulation[3] – Measure			
Rate Frequency:			
50 Hz to 10 KHz Depth: (5 to 99) %	150 kHz to 10 MHz 10 MHz to 1.3 GHz	2.4 % 1.2 %	HP 8902A

Parameter/Range	Frequency	CMC[2, 6] (±)	Comments
Frequency Modulation[3] – Measure			
Rate Frequency			
20 Hz to 10 kHz ≤ 40 kHz_{peak}	250 kHz to 10 MHz	2.4 %	HP 8902A
50 Hz to 100 kHz ≤ 400 kHz_{peak}	10 MHz to 1.3 GHz	1.2 %	

V. Mechanical

Parameter/Equipment	Range	CMC[2, 4, 6, 11] (±)	Comments
Force[3] – Measure			
Compression Only	Up to 425 000 lbf	0.12 % full scale	Load cell systems
Tension Only	Up to 75 000 lbf	0.12 % full scale + 0.25 %	
Force[3] – Measuring Equipment	Up to 1000 lbf	0.02 % of range	NIST Class F weights
Scales and Balances[3]	(1 to 400) g 400 g to 37 kg 1 oz to 1000 lb	0.0002 % + 0.6*R* 0.0003 % + 0.6*R* 0.01 % + 0.6*R*	ASTM Class 1 weights, NIST Class F weights
Mass – Measure	(1 to 500) mg (1 to 5) g	11 µg 22 µg	Electronic microbalance and ASTM Class 0 and 1 weight sets
	(10 to 50) g 100 g 200 g 300 g 500 g 1 kg (1 to 2) kg (2 to 31) kg	44 µg 170 µg 310 µg 3.0 mg 3.2 mg 3.4 mg 36 mg 350 mg	Electronic balance and ASTM Class 0 and 1 weight sets

Parameter/Equipment	Range[7]	CMC[2, 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[3] – Measure (Torque Calibration)	0.02 in·ozf to 100 in·lbf 1 in·ozf to 2000 ft·lbf	0.05 % 0.3 %	Torque calibrators
Torque[3] – Measuring Equipment	(0 to 250) ft·lbf (250 to 2000) ft·lbf	0.03 % 0.05 %	Arms and weights
Pressure[3] – Measure and Measuring Equipment	(-29 to 0) in·Hg (0 to 15) psi (5 to 40) in·H_2O (40 to 400) in·H_2O (3 to 600) psi (3 to 18 000) psi (0 to 750) psi (750 to 6000) psi	0.005 in·Hg 0.003 psi 0.04 % 0.007 % 0.007 % 0.025 % 0.076 % 0.011 %	Transducer Dead weight testers Mensor CPC 8000
Durometer[3] – Spring Calibration (Force Only)	Types: A, B, C, D, DO, E O, OO	 0.6 duro unit 0.7 duro unit	Note: this is a limited calibration of ASTM D2240
Tachometer	(10 to 50 000) RPM	0.23 RPM	Universal counter (HP 53131A/HP 53120A)

VI. Optical

Parameter/Range	Range	CMC[2, 6] (±)	Comments
Light – Measure	(0 to 200) FC	2.8 %	STD Lamp

VII. Thermodynamics

Parameter/Equipment	Range	CMC[2] (±)	Comments
Temperature[3] – Measure	(-100 to 660) ºC (660 to 1450) ºC	0.01 ºC 0.6 ºC	SPRT and meter Type S T/C and meter
Temperature[3] – Measuring Equipment	(-30 to 250) ºC (250 to 400) ºC (400 to 650) ºC	0.04 ºC 0.5 ºC 0.7 ºC	SPRT and bath SPRT and dry blocks and dry wells
Infrared Thermometers	(30 to 450) ºC	0.5 ºC	Infrared Calibrator monitored with digital thermometer and SPRT
Relative Humidity – Measure[3]	(10 to 90) % RH	1.2 % RH	Digital hygrometer
Relative Humidity – Measuring Equipment	(10 to 90) % RH	0.5 % RH	Dual pressure humidity chamber

VIII. Time & Frequency

Parameter/Range	Frequency	CMC[2], 11 (±)	Comments
Frequency – Measuring Equipment	Up to 20 GHz	16 pHz/Hz	Frequency generators and MicroSemi Xli 1510-602 GPS receiver
Frequency – Measure	Up to 26.5 GHz	60 pHz/Hz	Frequency counter and MicroSemi Xli 1510-602 GPS receiver

IX. Dimensional Testing/Calibration

Parameter/Range	Range	CMC[2, 4] (±)	Comments
Length – 1D[9]	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

[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 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 nominal length in inches; *R* is the resolution in inches; *F* is the nominal length in feet.

[5] The measurands stated are generated with the Fluke 5500A, 8508A, and 732A series of instruments. This capability is suitable for the calibration of the devices intended to measure the stated measurands in the ranges indicated. CMC are expressed as either a specific value that covers the full range or as a fraction of the reading plus a fixed floor specification.

[6] In the statement of CMC, the value is defined as the percentage of reading, unless otherwise noted.

[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*.

[11] 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.

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 3rd day of December 2018.

President and CEO
For the Accreditation Council
Certificate Number 0723.01
Valid to November 30, 2020

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