



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

JJ CALIBRATIONS, INC.
 7007 SE Lake Road
 Portland, OR 97267-2105
 Eric Johansen Phone: 503 786 3005

CALIBRATION

Valid To: November 30, 2012

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 calibrations¹:

I. Acoustical Quantities

Parameter/Range ⁴	Frequency	CMC ² (±)	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 ^{2,5} (±)	Comments
Gage Blocks	(0.01 to 4) in (4 to 20) in	(2.9 + 1.2L) µin (8.6 + 1.2L) µin	Mechanical comparison (metric to 300 mm available)
Thread Wires	All sizes, English and metric up to 0.3 inches	10 µin	P&W Labmaster

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Surface Roughness ³	Ra, Rq (2 to 1600) μin Rz, Ry (10 to 6400) μin	6 % of rdg	Surface tester
60° Thread Plugs – Pitch Diameter	Up to 12 in	(75 + 5L) μin	P&W Labmaster and thread wires
Adjustable Thread Rings ³	Up to 12 in	(200 + 50L) μin	Thread setting plugs
Protractors ³ (Digital, Etched)	0.25° to 90°	0.6R	Gage blocks and sine bar
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	0.00015 in/ft	Gage blocks
Micrometers ³ (Head, Inside, Outside, Depth)	Up to 84 in	10L μin + 0.6R	Gage blocks
Calipers ³ (Dial, Digital, Vernier, Gear Tooth Vernier)	Up to 84 in	10L μin + 0.6R	Gage blocks
Bore Micrometers ³	Up to 6 in	10L μin + 0.6R	Gage blocks
Indicators ³ (Dial, Digital, Test Travel)	Up to 12 in	10L μin + 0.6R	Gage blocks
Height Gages ³ (Dial, Digital, Vernier, Digi-Chek)	Up to 48 in	10L μin + 0.6R	Gage blocks

Parameter/Equipment	Range ⁴	CMC ^{2,5} (±)	Comments
Thickness Gages ³	Up to 1 in	10L μin + 0.6R	Gage blocks
Surface Plate Flatness ³	Up to 16 ft	20F μin	Opto-Dyne laser
Radius Gage	Up to 1 in	0.0003 in	Optical comparator
Length End Standards, Snap and Step Gages	Up to 13 in	(6 + 1.0L) μin	P&W Labmaster
Bore Gages ³ (3 points)	Up to 6 in	(0.6R + 30L) μin	Ring gages
Plain Ring Gages, Plugs and Pins	Up to 13 in	(6 + 1.0L) μin	P&W Labmaster
Coordinate Measurements ³ – Linear Axis Displacement (X-Y-Z)	Up to 2400 in	20F μin	Opto-Dyne laser
Optical Comparator ³ – Linear Axis Only (X, Y)	Up to 30 in	0.0002 in	Glass scales
Coating Thickness ³	(0.25, 0.85, 3) mil 10 mil 60 mil	0.16 mil 0.19 mil 0.22 mil	Thickness standard

III. Electrical – DC/Low Frequency

Parameter/Equipment	Range ⁴	CMC ² (±)	Comments
DC Voltage ³ – Measure and Generate	(10 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 and Generate	(1 to 10) kV (10 to 60) kV	0.12 % of rdg 0.20 % of rdg	HV meter HV divider
DC Voltage – Measure and Generate	(10 to 200) mV (0.2 to 2) V (2 to 20) V (20 to 200) V (200 to 1000) V 100 mV 1 V 10 V 100 V 1000 V	4.5 μV/V + 0.1 μV 3 μV/V + 0.4 μV 3 μV/V + 4 μV 4.5 μV/V + 40 μV 4.5 μV/V + 0.5 mV 1.2 μV/V 0.62 μV/V 0.5 μV/V 0.62 μV/V 0.82 μV/V	Fluke 8508A Fluke 732A and 752A
DC Current ³ – Measure and Generate Loop Amps	(10 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 (100 to 550) A	12 μA/A + 400 pA 12 μA/A + 4 nA 14 μA/A + 40 nA 48 μA/A + 0.8 μA 0.019 % rdg + 16 μA 0.04 % rdg + 400 μA 0.3 % rdg + 0.5 mA	Fluke 8508A Fluke 5500A with Fluke 50-turn coil
DC Current – Measure and Generate	(10 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 % rdg + 16 μA 0.038 % rdg + 400 μA	Fluke 8508A

Parameter/Equipment	Range	CMC ² (±)	Comments
DC Current ³ – Measure and Generate	(20 to 100) mA 100 mA to 1A (1 to 10) A (10 to 20) A	10 μA/A + 100 nA 20 μA/A + 1 μA 50 μA/A + 10 μA 80 μA/A + 100 μA	Fluke 8508A and standard resistors
Capacitance ³ – 1 kHz 1 kHz 100 Hz 20 Hz	1 pF to 10 μF (10 to 100) μF (0.1 to 1) mF (1 to 10) mF	0.03 % rdg 0.05 % rdg 0.05 % rdg 0.05 % rdg	Gen Rad 1693
Resistance – Measure and Generate	(1 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	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 % of rdg + 100 kΩ 0.053 % of rdg + 10 MΩ	Fluke 8508A HV mode
Resistance ³ – Measure and Generate	(1 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	17 μΩ/Ω + 4 μΩ 9.5 μΩ/Ω + 14 μΩ 8 μΩ/Ω + 50 μΩ 8 μΩ/Ω + 0.5 mΩ 8 μΩ/Ω + 5 mΩ 8 μΩ/Ω + 50 mΩ 9 μΩ/Ω + 1 Ω 20 μΩ/Ω + 100 Ω 0.012 % of rdg + 10 kΩ 0.018 % of rdg + 100 kΩ 0.15 % of rdg + 10 MΩ	Fluke 8508A HV mode

Parameter/Equipment	Range ⁴	CMC ² (±)	Comments
Resistance – Measure and Generate	0.001 Ω 0.01 Ω 0.1 Ω 1 Ω	80 μΩ/Ω 50 μΩ/Ω 20 μΩ/Ω 10 μΩ/Ω	Standard resistor comparison
	10 kΩ	0.5 μΩ/Ω	ESI SR 104 & Fluke 8508A
Inductance ³ – Measure and Generate	50 μH to 1 H	0.25 % of rdg	Gen Rad 1693

Parameter/Range	Frequency	CMC ² (±)	Comments	
AC Voltage – Measure and Generate	(100, 200) mV	20 Hz to 100 kHz (300 to 500) kHz 800 kHz to 1 MHz	0.01 % of rdg 0.025 % of rdg 0.03 % of rdg	Fluke 792A & 8508A
	(0.6, 1, 2,6,10,20) V	20 Hz to 100 kHz 300 to 1 MHz	0.01 % of rdg 0.015 % of rdg	
	(60, 100, 200, 600, 1000) V	20 Hz to 100 kHz	0.1 % of rdg	
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 % of rdg + 4 μV 0.035 % of rdg + 4 μV 0.08 % of rdg + 20 μV	Fluke 8508A
	(0.2 to 200) V	10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.012 % of rdg + 2 mV 0.023 % of rdg + 4 mV 0.06 % of rdg + 20 mV	
	(200 to 1000) V	10 Hz to 10 kHz	0.015 % of rdg + 20 mV	Above 300 V, add 0.00004* (reading - 300) ² μV/V

Parameter/Range	Frequency	CMC ² (±)	Comments
AC Voltage ³ – Measure only			
(1 to 10) kV	60 Hz	0.5 % of rdg	HV meter
(10 to 25) kV	60 Hz	5 % of rdg	Fluke 80K-40
AC Current ³ – Measure and Generate			
200 μA to 20 mA	1 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.031 % of rdg + 2 μA 0.071 % of rdg + 2 μA 0.4 % of rdg + 2 μA	Fluke 8508A
(20 to 200) mA	1 Hz to 10 kHz (10 to 30) kHz	0.031 % of rdg + 20 μA 0.063 % of rdg + 20 μA	
200 mA to 2 A	10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz	0.062 % of rdg + 200 μA 0.073 % of rdg + 200 μA 0.3 % + 200 μA	
(2 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	0.082 % of rdg + 2 mA 0.025 % of rdg + 2 mA	
Loop Amps (100 to 550) A	(45 to 65) Hz	0.35 % rdg + 3 mA	Fluke 5500A with Fluke 50-turn coil
AC Current – Measure and Generate			
200 μA to 20 mA	1 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.029 % of rdg + 2 μA 0.065 % of rdg + 2 μA 0.4 % of rdg + 2 μA	Fluke 8508A
(20 to 200) mA	1 Hz to 10 kHz (10 to 30) kHz	0.029 % of rdg + 20 μA 0.06 % of rdg + 20 μA	
200 mA to 2 A	10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz	0.06 % of rdg + 200 μA 0.07 % of rdg + 200 μA 0.3 % of rdg + 200 μA	
(2 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	0.08 % of rdg + 2 mA 0.025 % of rdg + 2 mA	

Parameter/Equipment	Range ⁴	CMC ² (±)	Comments
Oscilloscopes ³ –			
Gain 1 MΩ	(1 to 21) mV (21 to 556) mV 556 mV to 210 V	1.2 % of rdg + 15 μV 0.12 % of rdg + 1 μV 0.6 % of rdg + 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 % of rdg + 10 μV 0.12 % of rdg + 15 μV 0.12 % of rdg + 1 μV 0.12 % of rdg + 1 μV	
Ground	0 V	15 μV	
Flatness @ 50 Ω	(100 to 550) MHz (0.55 to 1.1) GHz (1.1 to 3.2) GHz	3.5 % of rdg 4.6 % of rdg 5.8 % of rdg	
Fast Edge – Bandwidth/Rise & Fall Times	150 ps	30 +5/-0 ps	
Time Markers	450 ps to 55 s	12 x 10 ⁻⁶ s	
Electrical Calibration of PRT Indicators ³ –			
Pt 385, 100 Ω	-200 °C to -80 °C -80 °C to 0 °C 0 °C to 100 °C 100 °C to 300 °C 300 °C to 400 °C 400 °C to 630 °C 630 °C to 800 °C	0.06 °C 0.06 °C 0.08 °C 0.10 °C 0.10 °C 0.20 °C 0.30 °C	Fluke 5500A
PtNi 385, 120 Ω	-80 °C to 0 °C 0 °C to 100 °C 100 °C to 260 °C	0.09 °C 0.09 °C 0.14 °C	
Pt 3926, 100 Ω	-200 °C to -80 °C -80 °C to 0 °C 0 °C to 100 °C 100 °C to 300 °C 300 °C to 400 °C 400 °C to 630 °C	0.06 °C 0.06 °C 0.8 °C 0.10 °C 0.10 °C 0.20 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of Thermocouple Indicators ³ –			
Type E	-250 °C to -100 °C -100 °C to -25 °C -25 °C to 350 °C 350 °C to 650 °C 650 °C to 1000 °C	0.5 °C 0.16 °C 0.14 °C 0.16 °C 0.21 °C	Fluke 5500A
Type J	-210 °C to -100 °C -100 °C to -30 °C -30 °C to 150 °C 150 °C to 760 °C 760 °C to 1200 °C	0.27 °C 0.16 °C 0.14 °C 0.17 °C 0.23 °C	
Type K	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 1000 °C 1000 °C to 1372 °C	0.33 °C 0.18 °C 0.16 °C 0.26 °C 0.4 °C	
Type R	0 °C to 250 °C 250 °C to 400 °C 400 °C to 1000 °C 1000 °C to 1767 °C	0.57 °C 0.35 °C 0.33 °C 0.4 °C	
Type S	0 °C to 250 °C 250 °C to 1000 °C 1000 °C to 1400 °C 1400 °C to 1767 °C	0.47 °C 0.36 °C 0.37 °C 0.46 °C	
Type T	-250 °C to -150 °C -150 °C to 0 °C 0 °C to 120 °C 120 °C to 400 °C	0.63 °C 0.24 °C 0.16 °C 0.14 °C	

IV. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC ² (±)	Comments
Attenuation ³ – (0 to -100) dBm	0.1 MHz to 1.3 GHz	0.08 dB	HP 8902A

Parameter/Range	Frequency	CMC ² (±)	Comments
Power ³ – Measure (-70 to +20) dBm	10 MHz to 26 GHz	3.8 % of rdg	HP 437B & 8485A
Modulation ³ – Amplitude Mod Rates	50 Hz to 10 KHz		HP 8902A
Mod Depth	5 % to 99 %		
Freq. Range	150 kHz to 10 MHz 10 MHz to 1.3 GHz	2.4 % of rdg 1.2 % of rdg	
Frequency Mod Rates Deviation	20 Hz to 10 kHz ≤ 40 kHz _{peak}	2.4 % of rdg	
Freq. Range	250 kHz to 10 MHz		
Mod Rates Deviation Freq. Range	50 Hz to 100 kHz ≤ 400 kHz _{peak} 10 MHz to 1.3 GHz	1.2 % of rdg	

V. Mechanical

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Force ³ – Measure, Compression Only	Up to 425 000 lbf	0.12 % full scale	Load cells
Force ³ – Measuring Equipment	Up to 1000 lbf	0.02 % of range	Class F weights
Scales & Balances ³	(1 to 400) g 400 g to 37 kg 1 oz to 1000 lb	0.0002 % of rdg + 0.6R 0.0003 % of rdg + 0.6R 0.01 % of rdg + 0.6R	Class 1 weights Class F weights

Parameter/Equipment	Range ⁴	CMC ² (±)	Comments
Mass – Measure	(1 to 500) mg (1 to 5) g	11 µg 22 µg	Electronic microbalance
	(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
Indirect Verification of Rockwell Hardness Testers	HRB: Low Medium High	1.2 HRB 1.2 HRB 1.2 HRB	Indirect verification per procedure DCN 500945
	HRC: Low Medium High	1.0 HRC 1.0 HRC 1.0 HRC	
Torque ³ – Measure (Torque Calibration)	1 in-oz to 2000 ft-lb	0.3 % of rdg	Torque calibrator
Torque ³ – Measuring Equipment	(0 to 250) ft-lb (250 to 2000) ft-lb	0.03 % of rdg 0.05 % of rdg	Arms and weights
Pressure ³ – Measure and Measuring Equipment	(-29 to 0) inHg (0 to 15) psi	0.005 inHg 0.003 psi	Transducer
	(5 to 400) inH ₂ O (10 to 600) psi (3 to 18 000) psi	0.02 % of rdg 0.02 % of rdg 0.025 % of rdg	Dead weight testers
Force Verification of Durometers – Linearity Only	Types: A, B, C, D, DO, E O, OO	100 duro unit 100 duro unit	ASTM D2240
Force Verification of Durometers ³ – Linearity Only	Types: A, B, C, D, DO, E O, OO	0.6 duro unit 0.7 duro unit	ASTM D2240

Parameter/Equipment	Range	CMC ² (±)	Comments
Tachometer	(10 to 50 000) rpm	0.23 RPM	HP 58503A GPS

VI. Thermodynamics

Parameter/Equipment	Range	CMC ² (±)	Comments
Temperature ³ – Measure	-100 °C to 660 °C	0.01 °C	SPRT and meter
	660 °C to 1450 °C	0.6 °C	Type S T/C and meter
Temperature ³ – Measuring Equipment	-30 °C to 250 °C	0.04 °C	SPRT and bath
	250 °C to 400 °C	0.5 °C	SPRT and dry well
	400 °C to 650 °C	0.7 °C	
Relative Humidity – Measure and Measuring Equipment	10 % RH to 95 % RH	0.5 % RH	Two pressure humidity generator

VII. Time & Frequency

Parameter/Range	Frequency	CMC ² (±)	Comments
Frequency – Measuring Equipment	10 MHz to 20 GHz	16 ρHz	HP 58503A GPS
Frequency – Measure	Up to 26.5 GHz	16 ρHz	HP 58503A GPS

¹ This laboratory offers commercial calibration service and field calibration service.

- ² Calibration and Measurement Capability (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. Calibration and Measurement Capabilities 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 Where ranges are not specified, the CMC stated is for the cardinal points only.
- ⁵ 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.



World Class Accreditation

The American Association for Laboratory Accreditation

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 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and any additional program requirements in the field of calibration. 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 25th day of January 2011.





President & CEO

For the Accreditation Council
Certificate Number 723.01
Valid to November 30, 2012

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