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 January 2009*).

Presented this 22nd day of January 2009.

President
For the Accreditation Council
Certificate Number 723.01
Valid to November 30, 2010

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

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

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CALIBRATION

Valid To: November 30, 2010 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]:

I. Acoustical Quantities

Parameter/Equipment[4]	Range	Best Uncertainty[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	Best Uncertainty[2, 5] (±)	Comments
Gage Blocks	(0.01 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 inches	10 µin	P&W Labmaster

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

Parameter/Equipment	Range[4]	Best Uncertainty[2, 5] (±)	Comments
Thickness Gages[3]	Up to 1 in	10*L* μin + 0.6*R*	Gage blocks
Surface Plate Flatness[3]	Up to 16 ft	20*F* 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 + 1.0*L*) μin	P&W Labmaster
Bore Gages[3] (3 points)	Up to 6 in	(0.6*R* + 30*L)* μin	Ring gages
Plain Ring Gages, Plugs and Pins	Up to 13 in	(6 + 1.0*L*) μin	P&W Labmaster
Coordinate Measurements[3] –			
Linear Axis Displacement (X-Y-Z)	Up to 384 in	20*F* μin	Opto-Dyne laser
CMM and Machine Tools	Up to 2400 in	20*F* μin	
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]	Best Uncertainty[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 % rdg 0.20 % 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 + 0.1µV 3 µV/V + 0.4µV 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	Best Uncertainty[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 % rdg + 100 kΩ 0.053 % 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 % rdg + 10 kΩ 0.018 % rdg + 100 kΩ 0.15 % rdg + 10 MΩ	Fluke 8508A HV mode

Parameter/Equipment	Range[4]	Best Uncertainty[2] (±)	Comments
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 0.5 μΩ/Ω	Standard resistor comparison ESI SR 104 & Fluke 8508A
Inductance[3] – Measure and Generate	50 μH to 1 H	0.25 % rdg	Gen Rad 1693

Parameter/Range	Frequency	Best Uncertainty[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 % rdg 0.025 % rdg 0.03 % rdg	Fluke 792A & 8508A
(0.6, 1, 2,6,10,20) V	20 Hz to 100 kHz 300 to1 MHz	0.01 % rdg 0.015 % rdg	
(60, 100, 200, 600, 1000) V	20 Hz to 100 kHz	0.1 % 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 % rdg + 4 μV 0.035 % rdg + 4 μV 0.08 % 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 % rdg + 2 mV 0.023 % rdg + 4 mV 0.06 % rdg + 20 mV	
(200 to 1000) V	10 Hz to 10 kHz	0.015 % rdg + 20 mV	Above 300 V, add 0.00004* (reading - 300)^2 μV/V

Parameter/Range	Frequency	Best Uncertainty[2] (±)	Comments
AC Voltage[3] – Measure only			
(1 to 10) kV	60 Hz	0.5 % rdg	HV meter
(10 to 25) kV	60 Hz	5 % 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 % rdg + 2 µA 0.071 % rdg + 2 µA 0.4 % rdg + 2 µA	Fluke 8508A
(20 to 200) mA	1 Hz to 10 kHz (10 to 30) kHz	0.031 % rdg + 20 µA 0.063 % rdg + 20 µA	
200 mA to 2 A	10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz	0.062 % rdg + 200 µA 0.073 % rdg + 200 µA 0.3 % + 200 µA	
(2 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	0.082 % rdg + 2 mA 0.025 % 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 % rdg + 2 µA 0.065 % rdg + 2 µA 0.4 % rdg + 2 µA	Fluke 8508A
(20 to 200) mA	1 Hz to 10 kHz (10 to 30) kHz	0.029 % rdg + 20 µA 0.06 % rdg + 20 µA	
200 mA to 2 A	10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz	0.06 % rdg + 200 µA 0.07 % rdg + 200 µA 0.3 % rdg + 200 µA	
(2 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	0.08 % rdg + 2 mA 0.025 % rdg+ 2 mA	

Parameter/Equipment	Range[4]	Best Uncertainty[2] (±)	Comments
Oscilloscopes[3] –			
Gain			
1 MΩ	(1 to 21) mV (21 to 556) mV (556 to 210) mV	1.2 % rdg + 15 µV 0.12 % rdg + 1 µV 0.6 % 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 % rdg + 10 µV 0.12 % rdg + 15 µV 0.12 % rdg + 1 µV 0.12 % 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 % rdg 4.6 % rdg 5.8 % 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 ºC to -80 ºC -80 ºC to 0 ºC 0 ºC to 100 ºC 100 ºC to 300 ºC 300 ºC to 400 ºC 400 ºC to 630 ºC 630 ºC to 800 ºC	0.06 ºC 0.06 ºC 0.08 ºC 0.10 ºC 0.10 ºC 0.20 ºC 0.30 ºC	Fluke 5500A
PtNi 385, 120 Ω	-80 ºC to 0 ºC 0 ºC to 100 ºC 100 ºC to 260 ºC	0.09 ºC 0.09 ºC 0.14 ºC	
Pt 3926, 100 Ω	-200 ºC to -80 ºC -80 ºC to 0 ºC 0 ºC to 100 ºC 100 ºC to 300 ºC 300 ºC to 400 ºC 400 ºC to 630 ºC	0.06 ºC 0.06 ºC 0.8 ºC 0.10 ºC 0.10 ºC 0.20 ºC	

Parameter/Equipment	Range	Best Uncertainty[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 1 000 °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 1 200 °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 1 000 °C 1000 °C to 1 372 °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 1 000 °C 1 000 °C to 1 767 °C	0.57 °C 0.35 °C 0.33 °C 0.4 °C	
Type S	0 °C to 250 °C 250 °C to 1 000 °C 1 000 °C to 1 400 °C 1 400 °C to 1 767 °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/Equipment	Range	Best Uncertainty[2] (±)	Comments
Attenuation[3] –			
(0 to -100) dBm	0.1 MHz to 1.3 GHz	0.08 dB	HP 8902A
Power[3] – Measure			
(-70 to +20) dBm	10 MHz to 26 GHz	3.8 % 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 % rdg 1.2 % rdg	
Frequency			
Mod Rates	20 Hz to 10 kHz	2.4 % rdg	
Deviation	≤ 40 kHz_{peak}		
Freq. Range	250 kHz to 10 MHz		
Mod Rates	50 Hz to 100 kHz	1.2 % rdg	
Deviation	≤ 400 kHz_{peak}		
Freq. Range	10 MHz to 1.3 GHz		

V. Mechanical

Parameter/Equipment	Range	Best Uncertainty[2] (±)	Comments
Force[3] – Measure, Compression Only	Up to 20 000 lbf	0.02 % range	Load cells
Force[3] – Measuring Equipment	Up to 1000 lbf	0.02 % range	Class F weights

Parameter/Equipment	Range[4]	Best Uncertainty[2] (±)	Comments
Scales & Balances[3]	(1 to 400) g 400 g to 37 kg 1 oz to 1000 lb	0.0002 % rdg + 0.6*R* 0.0003 % rdg + 0.6*R* 0.01 % rdg + 0.6*R*	Class 1 weights Class F weights
Mass – Measure	(1 to 500) mg (1 to 5) g (10 to 50) g 100 g 200 g 300 g 500 g 1 kg (1 to 2) kg (2 to 31) kg	11 µg 22 µg 45 µg 170 µg 300 µg 2.4 mg 2.7 mg 2.9 mg 36 mg 350 mg	Electronic microbalance Electronic balance
Indirect Verification of Rockwell Hardness Testers	HRB: Low Medium High HRC: Low Medium High	 1.2 HRB 1.2 HRB 1.2 HRB 1.0 HRC 1.0 HRC 1.0 HRC	Indirect verification
Torque[3] – Measure (Torque Calibration)	1 in·oz to 2000 ft·lb	0.3 % rdg	Torque calibrator
Torque[3] – Measuring Equipment	(0 to 250) ft·lb (250 to 2000) ft·lb	0.03 % rdg 0.05 % rdg	Arms and weights
Pressure[3] – Measure and Measuring Equipment	(-29 to 0) inHg (0 to 15) psi (5 to 400) inH_2O (10 to 600) psi (3 to 18 000) psi	0.005 inHg 0.003 psi 0.02 % rdg 0.02 % rdg 0.025 % rdg	Transducer Dead weight testers

Parameter/Equipment	Range	Best Uncertainty[2] (±)	Comments
Force Verification of Durometers – Linearity Only	Types: A, B, C, D, DO, E O, OO	 10 to 100 duro unit 10 to 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
Tachometer	(10 to 50 000) rpm	0.006 % rdg + 0.6*R*	Signal generator, LORAN-C

VI. Thermodynamics

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

VII. Time & Frequency

Parameter/Equipment	Range	Best Uncertainty[2] (±)	Comments
Frequency – Measuring Equipment	10 MHz to 20 GHz	20 pHz/Hz	Signal generators Referenced LORAN-C
Frequency – Measure	Up to 26.5 GHz	20 pHz/Hz	HP 5345A Referenced to LORAN-C

[1] This laboratory offers commercial and field calibration service, where noted.

[2] "Best Uncertainty" 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 of nearly ideal measuring equipment. Best uncertainties represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually a coverage factor of $k = 2$. The best uncertainty of a specific calibration performed by the laboratory may be greater than the best uncertainty due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

[3] Field calibration services are available for this parameter, where noted, and this laboratory meets A2LA *R104 – General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for these calibrations. The uncertainties achievable on a customer's site can be expected to be larger than the Best Measurement Capabilities (BMC) that the accredited laboratory has been assigned as Best Uncertainty 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 uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the calibration uncertainty being larger than the BMC.

[4] Where ranges are not specified, the best measurement uncertainty stated is for the cardinal points only.

[5] In the statement of best uncertainty, L is the nominal length in inches; R is the resolution in inches; F is the nominal length in feet.