



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

WEST CALDWELL CALIBRATION LABORATORIES, INC.  
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CALIBRATION

Valid To: January 31, 2018

Certificate Number: 1533.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations<sup>1</sup>:

I. Acoustical Quantities

Parameter/Range	Frequency	CMC <sup>2</sup> (±)	Comments
Acoustic Level – Measure 124 dB re 2 x 10 <sup>-5</sup> Pa (114 & 94) dB re 2 x 10 <sup>-5</sup> Pa	250 Hz 1 kHz	0.071 dB 0.079 dB	B&K 4228 B&K 4231
Acoustic Level – Measure <sup>3</sup> 124 dB re 2 x 10 <sup>-5</sup> Pa (114 & 94) dB re 2 x 10 <sup>-5</sup> Pa	250 Hz 1 kHz	0.12 dB 0.13 dB	B&K 4228 B&K 4231
Microphones – Measure, Actuator Response	250 Hz  20 Hz to 20 kHz 20 Hz to 50 kHz 20 Hz to 200 kHz	0.087 dB  0.099 dB 0.20 dB 0.30 dB	Comparison to B&K 4134 and B&K 4144  WB 0736 & UA0033 WB 0736 & UA0023

Parameter/Range	Frequency	CMC <sup>2</sup> (±)	Comments
Microphones – Measure <sup>3</sup> , Actuator Response	250 Hz 20 Hz to 200 kHz 20 Hz to 50 kHz	0.14 dB 0.35dB 0.25 dB	Comparison to B&K 4134 WB 0736 & UA0033 WB 0736 & UA0023
Acoustic Calibrators – Measure  124 dB re 2 x 10 <sup>-5</sup> Pa (74 to 134) dB re 2 x 10 <sup>-5</sup> Pa	250 Hz 31.5 Hz (63, 125, 250, 500) Hz (1, 2, 4, 8) kHz (12.5, 16) kHz	0.071 dB 0.10 dB 0.094 dB 0.094 dB 0.10 dB	B&K 4228 & 4134 B&K 4226 & 4180
Acoustic Calibrators – Measure <sup>3</sup>  124 dB re 2 x 10 <sup>-5</sup> Pa (74 to 134) dB re 2 x 10 <sup>-5</sup> Pa	250 Hz 31.5 Hz (63, 125, 250, 500) Hz (1, 2, 4, 8) kHz (12.5, 16) kHz	0.12 dB 0.15 dB 0.14 dB 0.14 dB 0.15 dB	B&K 4228 & 4134 B&K 4226 & 4180
Pistonphones – Generate  (114 to 134) dB re 2 x 10 <sup>-5</sup> Pa	250 Hz	0.074 dB	B&K 4228
Pistonphone – Generate <sup>3</sup>  (114 to 134) dB re 2 x 10 <sup>-5</sup> Pa	250 Hz	0.12 dB	B&K 4228
Acoustic Level – Generate Equipment  (94 to 114) dB re 2 x 10 <sup>-5</sup> Pa	31.5 Hz (63, 125, 250, 500) Hz (1, 2, 4, 8, 12.5) kHz 16 kHz	0.10 dB 0.094 dB 0.094 dB 0.10 dB	B&K 4226

Parameter/Equipment	Frequency	CMC <sup>2,4</sup> (±)	Comments
Acoustic Level – Generate Equipment <sup>3</sup>  (94 to 114) dB re 2 x 10 <sup>-5</sup> Pa	31.5 Hz (63, 125, 250, 500) Hz (1, 2, 4, 8, 12.5) kHz 16 kHz	0.15 dB 0.14 dB 0.14 dB 0.15 dB	B&K 4226
Simulated SPL Sound Level Meter Preamplifier, Measuring Amplifiers Analyzer & Filters – Measure and Measuring Equipment	10 Hz to 20 kHz 10 Hz to 50 kHz (50 to 100) kHz (100 to 250) kHz	0.011 dB 0.035 dB 0.039 dB 0.044 dB	AC voltage standard Agilent 33120A & 3458A
Simulated SPL Sound Level Meter Preamplifier Analyzer & Filters – Measure and Measuring Equipment <sup>3</sup>	10 Hz to 20 kHz (10 to 50) kHz (50 to 100) kHz (100 to 250) kHz	0.061 dB 0.085 dB 0.089 dB 0.094 dB	AC voltage standard Agilent 33120A & 3458A
Simulated SPL Sound Level Meter Preamplifier, Measuring Amplifiers Analyzer & Filters – Measure and Measuring Equipment	10 Hz to 20 kHz (10 to 50) kHz (50 to 100) kHz (100 to 250) kHz	0.024 dB 0.04 dB 0.06 dB 0.11 dB	AC voltage standard Agilent 33120A & 34401A
Simulated SPL Sound Level Meter, Preamplifier, Filters, Analyzers, and Measuring Amplifiers – Measuring Equipment <sup>3</sup>	10 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 250) kHz	0.056 dB 0.09 dB 0.11 dB 0.16 dB	AC voltage standard Agilent 33120A & 34401A
Electrical Input Sound & Vibration Analyzer – Measure	1 kHz 10 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.093 dB 0.098 dB 0.10 dB 0.11 dB 0.11 dB 0.52 dB	AC voltage standard Agilent 33120A & 34401A

Parameter/Equipment	Frequency	CMC <sup>2</sup> (±)	Comments
Electrical Input Sound & Vibration Analyzer – Measure <sup>3</sup>	1 kHz 10 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.14 dB 0.15 dB 0.15 dB 0.16 dB 0.16 dB 0.57 dB	AC voltage standard Agilent 33120A & 34401A
Microphones – Phase	10 Hz to 20 kHz 10 Hz to 10 kHz	0.28° 0.025°	B&K 3560 B&K 2133
Microphone – Phase <sup>3</sup>	1 kHz 10 Hz to 20 kHz	0.33° 0.33°	B&K 3560
Accelerometers – Phase	5 Hz to 10 kHz	0.061°	B&K 2034/9610
Dosimeters – Measuring Equipment	2 Hz to 20 kHz	0.30 dB	AC voltage standard Agilent 33120A, B&K 4226
Dosimeters – Measuring Equipment <sup>3</sup>	2 Hz to 20 kHz	0.35 dB	AC voltage standard Agilent 33120A, B&K 4226
Artificial Mastoid – Measure	100 Hz to 12.5 kHz  1 kHz	0.45 dB  0.80 dB	Constant force- frequency plot, B&K 8000  Force standard, B&K 8000

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2,4,5</sup> (±)	Comments
DC Voltage – Generate	Up to 320 mV (0.32 to 3.2) V (3.2 to 32) V (32 to 320) V (320 to 1050) V	0.036 % 0.036 % 0.036 % 0.036 % 0.036 %	Wavetek 9100
DC Voltage – Measure	Up to 100 mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	0.036 % 0.20 % 0.20 % 0.20 % 0.04 %	Agilent 3458A, Option II
DC Voltage – Measure <sup>3</sup>	1 mV to 1000 V	0.036 %	Agilent 34401A
DC Current – Generate	Up to 320 µA (0.32 to 3.2) mA (3.2 to 32) mA (32 to 320) mA (0.32 to 3.2) A	0.04 % 0.04 % 0.04 % 0.041 % 0.078 %	Wavetek 9100
DC Current – Measure	Up to 100 nA (0.1 to 10) µA (10 to 100) µA (0.1 to 100) mA (0.1 to 1) A	0.17 % 0.17 % 0.28 % 0.20 % 0.039 %	Agilent 3458A
DC Current – Measure <sup>3</sup> , Fixed Points	10 mA 100 mA 1 A 3 A	0.072 % 0.068 % 0.12 % 0.14 %	Agilent 34401A
Resistance – Generate	(40 to 400) Ω (0.4 to 4) kΩ (4 to 40) kΩ (40 to 400) kΩ (0.4 to 4) MΩ (4 to 40) MΩ	0.05 % + 20 mΩ 0.10 % + 80 mΩ 0.04 % + 0.8 Ω 1.3 % + 8 Ω 1.3 % + 0.1 Ω 2.7 % + 2.0 kΩ	Wavetek 9100

Parameter/Equipment	Range	CMC <sup>2, 4, 5</sup> (±)	Comments
Resistance – Measure	(1 to 10) Ω (10 to 100) Ω (0.1 to 1) kΩ (1 to 10) kΩ (10 to 100) kΩ (0.1 to 1) MΩ (1 to 10) MΩ	0.036 % + 10 μΩ 0.036 % + 10 μΩ 0.036 % + 100 μΩ 0.036 % + 1 mΩ 0.036 % + 10 mΩ 0.036 % + 100 mΩ 0.051 % + 1 Ω	Agilent 3458A

Parameter/Range	Frequency	CMC <sup>2, 4, 5</sup> (±)	Comments
AC Voltage – Generate  Up to 320 mV (0.32 to 3.2) V (0.32 to 32) V (32 to 320) V  (320 to 1050) V	10 Hz to 100 kHz     40 Hz to 1 kHz	0.23 % 0.25 % 0.42 % 0.41 %  0.078 %	Wavetek 9100
AC Voltage – Measure  10 mV     100 mV     1 V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz  (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz  40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.13 % + 3.3 μV 0.12 % + 3.3 μV 0.12 % + 3.3 μV 0.17 % + 3.3 μV 0.59 % + 3.3 μV 4.7 % + 3.3 μV  0.01 % 0.017 % 0.017 % 0.035 % 0.10 % 0.35 %  0.011 % 0.022 % 0.04 % 0.097 % 0.36 %	Agilent 3458A

Parameter/Range	Frequency	CMC <sup>2,4,5</sup> (±)	Comments
AC Voltage – Measure (cont)			
10 V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.01 % + 40 µV 0.01 % + 40 µV 0.02 % + 40 µV 0.03 % + 40 µV 0.09 % + 40 µV 0.35 % + 40 µV	Agilent 3458A
100 V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.02% + 4 mV 0.02 % + 4 mV 0.02 % + 4 mV 0.04 % + 4 mV 0.14 % + 4 mV 0.47 % + 4 mV	
1000 V	40 Hz to 1 kHz	0.047 % + 20 mV	
AC Voltage – Measure			
100 mV	10 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.13 % 0.18 % 0.66 % 4.7 %	Agilent 34401A
(1 to 750) V	10 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.06 % 0.13 % 0.70 % 4.7 %	
AC Voltage – Measure <sup>3</sup>			
100 mV	10 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.14 % 0.18 % 0.66 % 4.7 %	Agilent 34401A
(1 to 750) V	10 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.062 % 0.13 % 0.65 % 4.7 %	

Parameter/Range	Frequency	CMC <sup>2,4,5</sup> (±)	Comments
AC Current – Measure			
100 µA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 1) kHz	0.47 % + 0.04 µA 0.18 % + 0.04 µA 0.069 % + 0.04 µA 0.69 % + 0.04 µA	Agilent 3458A
(1 to 10) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 1) kHz	0.47 % 0.18 % 0.074 % 0.042 %	
(10 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 1) kHz	0.47 % + 0.03 µA 0.18 % + 0.03 µA 0.073 % + 0.03 µA 0.042 % + 0.03 µA	
1 A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 1) kHz	0.47 % + 0.03 mA 0.19 % + 0.03 µA 0.093 % + 0.03 µA 0.12 % + 0.03 µA	

### III. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC <sup>2</sup> (±)	Comments
Attenuator – Generate			
(0 to -60) dB	1 kHz	0.17 dB	WB 0785
(0 to -60) dB	DC to 200 kHz	0.56 dB	
(0 to -100) dB	10 Hz to 50 kHz	0.26 dB	
(0 to -100) dB	2 Hz to 200 kHz	0.46 dB	
Attenuator – Generate <sup>3</sup>			
(0 to -60) dB	1 kHz	0.22 dB	WB 0785
(0 to -60) dB	DC to 200 kHz	0.61 dB	
(0 to -100) dB	10 Hz to 50 kHz	0.31 dB	
(0 to -100) dB	2 Hz to 200 kHz	0.51 dB	



Parameter/Range	Frequency	CMC <sup>2</sup> (±)	Comments
Attenuator – Measure  (0 to -60) dB (0 to -60) dB (0 to -100) dB (0 to -100) dB	1 kHz DC to 200 kHz 10 Hz to 50 kHz 2 Hz to 200 kHz	0.17 dB 0.56 dB 0.26 dB 0.46 dB	B&K 2636, 2610
Attenuator – Measure <sup>3</sup>  (0 to -60) dB (0 to -60) dB (0 to -100) dB (0 to -100) dB	1 kHz DC to 200 kHz 10 Hz to 50 kHz 2 Hz to 200 kHz	0.22 dB 0.61 dB 0.31 dB 0.51 dB	B&K 2636, 2610

#### IV. Mechanical

Parameter/Range	Frequency	CMC <sup>2.5</sup> (±)	Comments
Velocity Transducer – Measure  (10 to 2500) mV/in·s <sup>-1</sup>  (10 to 10 000) mV/in·s <sup>-1</sup>	(15 to 1000) Hz  (10, 80, 100, and 160) Hz (0.5 to 10) Hz (10 to 40) Hz 40 Hz to 1 kHz (1 to 2) kHz	2.0 %  1.3 % 2.5 % 2.0 % 1.4 % 1.8 %	B&K 9610  Sensitivity frequency response plot B&K 3560, 4808, 4809
Calibration Exciters	100 Hz to 160 Hz 10 Hz to 10 kHz  10 Hz to 10 kHz  100 Hz to 160 Hz 10 Hz to 10 kHz  100 Hz to 160 Hz 10 Hz to 10 kHz	1.2 % 2.5 %  2.7 %  1.3 % 2.5 %  1.3 % 2.5 %	B&K 8305/2635  B&K 4393/2635  B&K 4371/2635  PCB 353B04/Power Supply

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
Calibration Exciters <sup>3</sup>	100 Hz to 160 Hz 10 Hz to 10 kHz	1.3 % 2.5 %	B&K 8305/2635
	10 Hz to 10 kHz	2.8 %	B&K 4393/2635
	100 Hz to 160 Hz 10 Hz to 10 kHz	1.4 % 2.6 %	B&K 4371/2635
	100 Hz to 160 Hz 10 Hz to 10 kHz	1.4 % 2.6 %	PCB 353B04/power supply
Random Noise – Measure	100 Hz to 20 kHz 20 kHz to 200 kHz	0.30 dB 0.50 dB	B&K 1617/2636
	100 Hz to 10 kHz 20 Hz to 20 kHz	0.30 dB 0.50 dB	B&K 2133 B&K 3560
Random Noise <sup>3</sup> – Measure	100 Hz to 20 kHz 20 Hz to 20 kHz	0.30 dB 0.50 dB	B&K 3560
Dynamic Force Transducer – Measure  (0.05 to 0.25) N  5 N	100 Hz 160 Hz 100 Hz to 35 kHz	2.0 % 2.0 % 4.0 %	B&K 4809 & WA0426
	100 Hz to 12.5 kHz	3.0 %	B&K 8000
Dynamic Pressure Sensor – Measure	250 Hz	0.18 dB	B&K 4228
	20 Hz to 200 kHz	1.0 dB	WB 0736 & UA0033 stepped sine response

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments	
Accelerometers – Measure				
Charge	100 Hz and 160 Hz	1.3 %	B & K 9610 (0.02 to 5000) pC/g B&K 4808, 4809	
	(5 to 10) Hz	1.4 %		
	(10 to 40) Hz	1.3 %		
	40 Hz to 2 kHz	1.4 %		
	(2 to 4) kHz	1.8 %		
	(4 to 7) kHz	2.2 %		
	(7 to 10) kHz	2.5 %		
	(2 to 45) kHz	4.0 %		Freq. response plot B&K 4290 (0.02 to 5000) pC/g
Voltage	100 Hz and 160 Hz	1.3 %		B & K 9610 (0.02 to 5000) mV/g B&K 4808, 4809
	(5 to 10) Hz	2.0 %		
	(10 to 40) Hz	1.6 %		
	40 Hz to 2 kHz	1.4 %		
	(2 to 4) kHz	1.8 %		
	(4 to 7) kHz	2.2 %		
	(7 to 10) kHz	2.5 %		
	(2 to 45) kHz	4.0 %	Freq. response plot B&K 4290 (0.02 to 5000) mV/g	
Voltage and Charge			Sensitivity frequency response plot B&K 3560, 4808, 4809	
(0.02 to 10 000) mV/g	(10, 80, 100, and 160) Hz	1.3 %		
(0.02 to 10 000) pC/g	(0.5 to 10) Hz	2.5 %		
	(10 to 40) Hz	2.0 %		
	40 Hz to 2 kHz	1.4 %		
	(2 to 4) kHz	1.8 %		
	(4 to 7) kHz	2.2 %		
	(7 to 20) kHz	2.5 %		

#### IV. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Frequency – Measure	DC to 10 MHz	5.0 parts in 10 <sup>9</sup> Hz	Agilent 34401A

<sup>1</sup> This laboratory offers commercial calibration services and field calibration services.

<sup>2</sup> 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.

<sup>3</sup> 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 CMCs 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 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.

<sup>4</sup> Based on using the standard at the temperature the Agilent 3458A was calibrated ( $t_{cal} \pm 5 \text{ }^\circ\text{C}$ ) and an auto-calibration (ACAL) was performed within the previous 24 hours ( $\pm 1 \text{ }^\circ\text{C}$  of ambient temperature).

<sup>5</sup> In the statement of CMC, percentages are to be read as percent of reading.