



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005
ANSI/NCSL Z540-1-1994 & ANSI/NCSL Z540.3

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CALIBRATION

Valid To: October 31, 2017

Certificate Number: 2123.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations¹:

I. Electrical – RF/Microwave

Parameter/Equipment	Frequency	CMC ² (±)	Comments
ISN ³ –			CISPR: 22 and 16-1-2
Phase	150 kHz to 80 MHz	3.0°	
Insertion Loss	150 kHz to 80 MHz	0.36 dB	HP 8751A & HP 87512A E5071C, HP 4395A
Impedance	150 kHz to 80 MHz	2.4 Ω	
Longitudinal Conversion Loss	150 kHz to 80 MHz	0.88 dB	
Decoupling Attenuation	150 kHz to 80 MHz	0.36 dB	

Parameter/Equipment	Frequency	CMC ^{2,4,5} (\pm)	Comments
LISN ³ –			ANSI C63.4, CISPR: 25 and 16-1-2
Insertion Loss	9 kHz to 108 MHz (108 to 400) MHz	0.66 dB + <i>M</i> 0.86 dB + <i>M</i>	HP 8751 & HP 87512A, BNC and Type “N” calibration standards
	150 kHz to 100 MHz (100 to 200) MHz	0.38 dB 0.61 dB	
	(200 to 400) MHz	1.4 dB	
	(400 to 600) MHz	1.3 dB	
	(600 to 800) MHz	1.4 dB	
	800 MHz to 1 GHz	2.3 dB	
	Impedance – Magnitude	9 kHz to 100 MHz (100 to 200) MHz (200 to 400) MHz	
150 kHz to 100 MHz (100 to 200) MHz		0.35 Ω 1.3 Ω	
(200 to 400) MHz		2.3 Ω	
(400 to 600) MHz		2.2 Ω	
(600 to 800) MHz		1.9 Ω	
800 MHz to 1 GHz		2.2 Ω	
Impedance – Phase		9 kHz to 100 MHz (100 to 200) MHz (200 to 400) MHz	3.6° 3.4° 3.2°
	Isolation	9 kHz to 100 MHz (100 to 200) MHz (200 to 400) MHz	0.36 dB 1.1 dB 1.6 dB
		RF Power, Absolute ³ – Measure	
9 kHz to 6000 MHz		(-30 to -20) dBm (-20 to -10) dBm (-10 to 0) dBm (0 to 10) dBm (10 to 20) dBm	0.9 % + <i>M</i> 0.8 % + <i>M</i> 0.65 % + <i>M</i> 0.55 % + <i>M</i> 0.45 % + <i>M</i>
50 MHz to 50 GHz	(-30 to 20) dBm (-70 to -20) dBm	0.8 % + <i>M</i> 1.4 % + <i>M</i>	HP 8487A HP 8487A

Parameter/Range	Frequency	CMC ^{2,4} (\pm)	Comments
RF Power ³ – Generate	9 kHz to 2.5 GHz (2.5 to 3.2) GHz (3.2 to 4) GHz 1 Hz to 15 MHz 10 MHz to 2 GHz @ ≥ -10 dBm (2 to 20) GHz (20 to 40) GHz	1 dB 1.5 dB 2 dB 0.1 dB 0.6 dBm 0.7 dBm 0.9 dBm	HP 8648D HP 33120 HP 83640L HP 83640L
Current Probes ³ & Bulk Current Injection Probes ³ – Insertion Loss Transfer Impedance	5 Hz to 500 MHz 500 MHz to 2.4 GHz 5 Hz to 500 MHz 500 MHz to 2.4 GHz	0.77 dB + <i>M</i> 1.1 dB + <i>M</i> 0.77 dB + <i>M</i> 1.1 dB + <i>M</i>	CISPR 16-1-2, IEC/EN 61000-4-6 HP 8751A & HP 87512A, BNC and Type “N” calibration standards
CDN’s & Adapters ³ – (50 to 150) Ω Adapter Insertion Loss Coupling Factor Impedance	10 kHz to 230 MHz 10 kHz to 230 MHz 10 kHz to 230 MHz	1.2 dB + <i>M</i> 1.1 dB + <i>M</i> 3.5 Ω	IEC/EN 61000-4-6 CISPR 16-1-2 HP 8751A & HP 87512A, BNC and Type “N” calibration standards
Absorbing Clamps	30 MHz to 1 GHz	2.4 dB	CISPR 16-1-3, HP 8593E
Injection Clamps ³	(0.01 to 1000) MHz	1.6 dB	IEC/EN 61000-4-6, HP 8593E
Magnetic Field Strength Meters – DC (15 to 19) mG (150 to 190) mG (60 to 700) mG	(5 to 20) Hz 20 Hz to 2 kHz (2 to 500) kHz	0.73 dB 0.73 dB 1.1 dB 1.1 dB	Standard field using Helmholtz coil

Parameter/Range	Frequency	CMC ^{2,4,5} (±)	Comments
NSA Measurements ³	(30 to 1000) MHz	0.5 dB	ANSI C63.4: (2003, 2009, 2010, and 2014) EN 50147-2 (1997) CISPR: 25 and 16-1-4 HP 8591E, HP 8593EM
	(30 to 1000) MHz	0.1 dB	HP 8753D, E8364B, Agilent N5230A
Shielding Effectiveness ³	1 kHz to 1 GHz	0.5 dB	EN 50147-1 (1997), IEE 299 (2006), NSA 94-106 (1999) HP 8591E, HP 8593EM
	(1 to 18) GHz	0.6 dB	HP 8753D, E8364B, Agilent N5230A
Site VSWR Measurements ³	(1 to 3) GHz	0.66 dB	CISPR 16-1-4 (2010), Clauses 8.3.3-8.4, E8364B
	(3 to 18) GHz	0.84 dB	
Field Uniformity ³	26 MHz to 18 GHz	1.2 dB	EN 61000-4-3 Ed. 3.2
ESD Simulators ³ –			IEC/EN 61000-4-2 ISO 10605
Contact Voltage (Positive and Negative)	(0.5 to 2) kV	2.6 %	TDS 7404B
	(2 to 8) kV	0.7 %	
	(8 to 15) kV	0.6 %	
	(15 to 30) kV	0.54 %	
Rise Time	(0.6 to 1) ns	65 ps	MD 102 target 20 dB attenuator
Peak Current	(6.8 to 33) A	5.0 %	
30 ns Current	(2.8 to 20.8) A	5.6 %	
60 ns Current	(1.4 to 10.4) A	6.1 %	
Air Discharge Voltage (Positive and Negative)	(0.5 to 25) kV	2.0 %	SAE J1113-13

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
ESD Simulators ³ – (cont)			ISO 10605
Rise Time	(0.7 to 1) ns	65 ps	TDS 7404B scope,
RC Time Constant (at ± 15 kV)	600 ns ± 130 ns (for 330 pF probe) 300 ns ± 60 ns (for 150 pF probe)	7.3 ns 6.2 ns	MD 102 target 20 dB attenuator
Indicated Voltage	(2 to 30) kV	4.5 %	Electrometer 6514 and probe MHEP-1
RF Isotropic E-Field Probe –			
Anechoic Chamber Linearity Isotropic	45 GHz	1.7 dB 0.54 dB 0.47 dB	FEP 7050 probes using substitution method
Anechoic Chamber Linearity Isotropic	60 GHz	1.8 dB 0.72 dB 0.47 dB	FEP 7060 probes using substitution method
TEM Cell Frequency Resp Linearity Isotropic	9 kHz to 200 MHz	0.91 dB 0.91 dB 0.92 dB	Calculated/ substitution
GTEM Frequency Resp Linearity Isotropic	10 kHz to 1000 MHz	0.97 dB 0.97 dB 0.97 dB	Calculated/ substitution
Tri-plate Linearity Isotropic	10 kHz to 1000 MHz	0.89 dB 1.2 dB 1.2 dB	Calculated/ substitution
Anechoic Chamber Linearity Isotropic	(1000 to 18 000) MHz	1.1 dB 1.2 dB 1.2 dB	Calculated/ substitution
Anechoic Chamber Linearity Isotropic	(18 000 to 40 000) MHz	2.0 dB 1.1 dB 1.1 dB	Calculated/ substitution

Parameter/Equipment	Range	CMC ² (±)	Comments
RF Laser Isotropic E-Field Probe –			
TEM Cell Frequency Resp	5 kHz to 200 MHz	0.73 dB	Calculated/ substitution
Linearity	9 kHz to 200 MHz	0.91 dB	
Isotropic	9 kHz to 200 MHz	0.92 dB	
GTEM Frequency Resp	10 kHz to 1000 MHz	0.81 dB	
Linearity		0.97 dB	
Isotropic		0.97 dB	
Anechoic Chamber	(1000 to 18 000) MHz	0.91 dB	
Linearity		1.1 dB	
Isotropic		1.1 dB	
Anechoic Chamber	(18 000 to 40 000) MHz	1.7 dB	
Linearity		1.7 dB	
Isotropic		1.7 dB	
Electronic E-Field Probes			IEEE 1309, IEC/EN 61000-4-3, substitution method
	10 kHz to 5000 MHz Correction Factor	1.3 dB	FP 5000 type probe
	10 kHz to 5000 MHz Linearity Factor	0.83 dB	FP 5000 type probe
	10 kHz to 5000 MHz Channel Match Factor	1 dB	FP 5000 type probe
	(200 to 1000) MHz Isotropic Response	0.83 dB	FP 5000 type probe
	80 MHz to 18 GHz Correction Factor	1.9 dB	FP 2080 type probe, calculated/substitution
	80 MHz to 18 GHz Linearity Factor	0.84 dB	FP 2080 type probe, calculated/substitution
	80 MHz to 18 GHz Channel Match Factor	1 dB	FP 2080 type probe , calculated/substitution

Parameter/Equipment	Range	CMC ^{2, 4} (\pm)	Comments
Electronic E-Field Probes (cont)	(18 to 40) GHz Correction Factor Linearity Channel Match Isotropic: (400 & 1000)	 2.3 dB 1.3 dB 1.3 dB 1.2 dB	FP2080 type probe
RF Pre-Amplifiers, Amplifiers ³ – Gain	 5 Hz to 18 GHz (18 to 50) GHz	 0.97 dB 1 dB	IEEE 291 HP 8591E, 8593E, E8364B
Reflection S_{11}/S_{22} – Magnitude ³ 5 Hz to 300 kHz 300 kHz to 6 GHz 10 MHz to 50 GHz	 (0 to 0.5) lin (0.5 to 1) lin (0 to 1) lin (0 to 1) lin	 $M + 0.05$ (lin) $M + 0.1$ (lin) $M + 0.1$ (lin) $M + 0.1$ (lin)	HP 8751 and 8753D w/ 85032B calibration kit E8364B w/ electronic calibration kit
Reflection S_{11}/S_{22} – Phase ³ 5 Hz to 300 kHz 300 kHz to 6 GHz 10 MHz to 18 GHz (18 to 50) GHz	 (0 to 180) $^{\circ}$ (0 to 180) $^{\circ}$ (0 to 180) $^{\circ}$ (0 to 180) $^{\circ}$	 3.5 $^{\circ}$ 3.3 $^{\circ}$ 3.5 $^{\circ}$ 4.1 $^{\circ}$	HP 8753D w/ 85032B calibration kit E8364B w/ electronic calibration kit
Transmission S_{12}/S_{21} – Magnitude ³ 5 Hz to 500 MHz 10 MHz to 50 GHz 10 Hz to 500 MHz (0.5 to 18) GHz	 (0 to 70) dB (0 to 70) dB (0 to 70) dB (0 to 70) dB	 0.15 dB 0.15 dB 0.97 dB 0.97 dB	E8364B w/ electronic calibration kit HP 8591E, HP 8593E

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Transmission S ₁₂ /S ₂₁ – Magnitude ³ (cont)			
300 kHz to 6 GHz	(0 to 30) dB (30 to 40) dB (40 to 50) dB (50 to 60) dB (60 to 70) dB	M + 0.07 dB M + 0.08 dB M + 0.09 dB M + 0.1 dB M + 0.15 dB	HP 8753D w/ 85032B calibration kit
10 MHz to 18 GHz	(0 to 12) dB (12 to 40) dB (40 to 60) dB (60 to 70) dB	M + 0.05 dB M + 0.07 dB M + 0.08 dB M + 0.15 dB	E8364B w/ electronic calibration kit
Transmission S ₁₂ /S ₂₁ – Phase ³			
5 Hz to 500 MHz	(0 to 180)°	3.5°	E8364B w/ electronic calibration kit
10 MHz to 50 GHz	(0 to 180)°	3.2°	E8364B w/ electronic calibration kit
300 kHz to 6 GHz	(0 to 180)°	3.7°	HP 8753D w/ 85032B calibration kit
10 MHz to 18 GHz	(0 to 180)°	3.9°	E8364B w/ electronic calibration kit

Parameter/Equipment	Frequency	CMC ² (±)	Comments
Antenna Pattern Measurements	(10 to 1000) MHz (1 to 40) GHz	0.87 dB 1 dB	E8364B w/ electronic calibration kit
Antenna Cross – Polar Response	(200 to 2000) MHz	0.5 dB	CISPR 16-1-4 H P8591E, HP 8593E
Antenna Balance	(20 to 300) MHz	0.5 dB	CISPR 16-1-4 HP 8591E, HP 8593E

Parameter/Equipment	Frequency	CMC ² (±)	Comments
Antenna VSWR	(20 to 2000) MHz (1 to 40) GHz	0.6 dB 0.9 dB	IEEE 149-1979 N5230A w/ electronic calibration kit
Rod Antennas ³ (ECSM)– Antenna Factor	10 Hz to 60 MHz	0.23 dB	CISPR 25, ANSI C63.5 SAE ARP 958, CISPR 16-1-4 HP 8751A & HP 87512A, BNC calibration standards
Loop Antennas	1 kHz to 30 MHz 10 Hz to 2 MHz 10 Hz to 30 MHz	0.32 dB 0.34 dB 0.44 dB	Standard field using Vacuo junction Standard field using loop current measurement Substitution method using reference antenna
Conical Log Spiral Antennas – 1 Meter Distance	(200 to 400) MHz (400 to 1000) MHz (1000 to 10 000) MHz	2.2 dB 0.88 dB 1.7 dB	SAE ARP 958 N5230A w/ electronic calibration kit, calibration site 2 ⁶
Dipole Antennas – 3 Meter Distance 3 Meter Distance	(30 to 60) MHz (50 to 150) MHz (140 to 400) MHz (400 to 1000) MHz (30 to 60) MHz (50 to 150) MHz (140 to 400) MHz (400 to 1000) MHz	0.5 dB 0.48 dB 0.55 dB 0.60 dB 0.52 dB 0.55 dB 0.60 dB 0.62 dB	ANSI C63.5 Standard site method, horizontal polarization, calibration site 2 ⁶ , HP 8591E, HP 8593EM Reference antenna method, horizontal polarization, calibration site 2 ⁶ , HP 8591E, HP 8593EM

Parameter/Equipment	Frequency	CMC ² (±)	Comments
Dipole Antennas – (cont)			ANSI C63.5
3 Meter Distance	(30 to 60) MHz (50 to 150) MHz (140 to 400) MHz (400 to 1000) MHz	0.45 dB 0.52 dB 0.45 dB 0.58 dB	Identical antenna method, horizontal polarization, calibration site 2 ⁶ , HP 8591E, HP 8593EM
10 Meter Distance	(30 to 60) MHz (50 to 150) MHz (140 to 400) MHz (400 to 1000) MHz	0.41 dB 0.45 dB 0.51 dB 0.55 dB	Standard site method, horizontal polarization, calibration site 2 ⁶ , HP 8591E, HP 8593EM
10 Meter Distance	(30 to 60) MHz (50 to 150) MHz (140 to 400) MHz (400 to 1000) MHz	0.35 dB 0.40 dB 0.45 dB 0.51 dB	Reference antenna method, horizontal polarization, calibration site 2 ⁶ , HP 8591E, HP 8593EM
10 Meter Distance	(30 to 60) MHz (50 to 150) MHz (140 to 400) MHz (400 to 1000) MHz	0.41 dB 0.38 dB 0.45 dB 0.50 dB	Identical antenna method, horizontal polarization, calibration site 2 ⁶ , HP 8591E, HP 8593EM
Biconical Antennas –			
1 Meter Distance	(30 to 70) MHz (70 to 200) MHz (200 to 300) MHz	0.33 dB 0.34 dB 0.37 dB	SAE ARP 958, calibration site 1, HP 8591E, HP 8593EM
3 Meter Distance	(30 to 70) MHz (70 to 200) MHz (200 to 300) MHz	0.37 dB 0.48 dB 0.37 dB	SAE ARP 958, Appendix C, calibration site 1, HP 8591E, HP 8593EM, N5230A w/ electronic calibration kit
3 Meter Distance	(30 to 70) MHz (70 to 200) MHz (200 to 300) MHz	0.93 dB 0.54 dB 0.25 dB	ANSI C63.5, Standard site method, horizontal polarization, calibration site 2 ⁶ , N5230A w/ electronic calibration kit

Parameter/Equipment	Frequency	CMC ² (±)	Comments
Biconical Antennas – (cont)			
3 Meter Distance	(30 to 72.5) MHz	0.95 dB	ANSI C63.5, Reference antenna method, horizontal polarization, calibration site 2 ⁶ , N5230A w/ electronic calibration kit
	(72.5 to 115) MHz	0.55 dB	
	(115 to 157.5) MHz	0.41 dB	
	(157.5 to 200) MHz	0.50 dB	
	(200 to 300) MHz	0.60 dB	
3 Meter Distance	(30 to 72.5) MHz	0.96 dB	ANSI C63.5, Identical antenna method, horizontal polarization, calibration site 2 ⁶ , N5230A w/ electronic calibration kit
	(72.5 to 115) MHz	0.6 dB	
	(115 to 157.5) MHz	0.39 dB	
	(157.5 to 200) MHz	0.47 dB	
	(200 to 300) MHz	0.52 dB	
10 Meter Distance	(30 to 72.5) MHz	0.93 dB	ANSI C63.5, Standard site method, horizontal polarization, calibration site 2 ⁶ , N5230A w/ electronic calibration kit
	(72.5 to 115) MHz	0.52 dB	
	(115 to 157.5) MHz	0.24 dB	
	(157.5 to 200) MHz	0.20 dB	
	(200 to 300) MHz	0.25 dB	
10 Meter Distance	(30 to 72.5) MHz	0.97 dB	ANSI C63.5, Reference antenna method, horizontal polarization, calibration site 2 ⁶ , N5230A w/ electronic calibration kit
	(72.5 to 115) MHz	0.62 dB	
	(115 to 157.5) MHz	0.41 dB	
	(157.5 to 200) MHz	0.30 dB	
	(200 to 300) MHz	0.31 dB	
10 Meter Distance	(30 to 72.5) MHz	0.96 dB	ANSI C63.5, Identical antenna method, horizontal polarization, calibration site 2 ⁶ , N5230A w/ electronic calibration kit
	(72.5 to 115) MHz	0.60 dB	
	(115 to 157.5) MHz	0.38 dB	
	(157.5 to 200) MHz	0.46 dB	
	(200 to 300) MHz	0.52 dB	
Log-Periodic Antennas –			
1 Meter Distance	(200 to 400) MHz	0.32 dB	SAE ARP 958 Calibration site 1, HP 8591E, HP 8593EM
	(400 to 1000) MHz	0.38 dB	
	(1000 to 5000) MHz	0.52 dB	
3 Meter Distance	(200 to 400) MHz	0.38 dB	SAE ARP 958, Appendix C, calibration site 1, HP 8591E, HP 8593E, N5230A w/ electronic calibration kit
	(400 to 1000) MHz	0.45 dB	
	(1000 to 5000) MHz	0.58 dB	

Parameter/Equipment	Frequency	CMC ² (±)	Comments
Log-Periodic Antennas – (cont)			
3 Meter Distance	(200 to 300) MHz (300 to 400) MHz (400 to 500) MHz (500 to 600) MHz (600 to 700) MHz (700 to 800) MHz (800 to 900) MHz (900 to 1000) MHz (1000 to 5000) MHz	0.3 dB 0.3 dB 0.4 dB 0.4 dB 0.4 dB 0.5 dB 0.5 dB 0.6 dB 0.7 dB	ANSI C63.5, Standard site method, horizontal polarization, calibration site 2 ⁶ , N5230A w/ electronic calibration kit
3 Meter Distance	(200 to 300) MHz (300 to 400) MHz (400 to 500) MHz (500 to 600) MHz (600 to 700) MHz (700 to 800) MHz (800 to 900) MHz (900 to 1000) MHz (1000 to 5000) MHz	0.2 dB 0.2 dB 0.2 dB 0.25 dB 0.35 dB 0.45 dB 0.45 dB 0.5 dB 0.6 dB	ANSI C63.5, Identical antenna method, horizontal polarization, calibration site 2 ⁶ , N5230A w/ electronic calibration kit
10 Meter Distance	(200 to 300) MHz (300 to 400) MHz (400 to 500) MHz (500 to 600) MHz (600 to 700) MHz (700 to 800) MHz (800 to 900) MHz (900 to 1000) MHz (1000 to 5000) MHz	0.3 dB 0.3 dB 0.4 dB 0.4 dB 0.4 dB 0.5 dB 0.5 dB 0.6 dB 0.7 dB	ANSI C63.5, Standard site method, horizontal polarization, calibration site 2 ⁶ , N5230A w/ electronic calibration kit
10 Meter Distance	(200 to 300) MHz (300 to 400) MHz (400 to 500) MHz (500 to 600) MHz (600 to 700) MHz (700 to 800) MHz (800 to 900) MHz (900 to 1000) MHz (1000 to 5000) MHz	0.3 dB 0.3 dB 0.3 dB 0.3 dB 0.45 dB 0.45 dB 0.55 dB 0.6 dB 0.7 dB	ANSI C63.5, Identical antenna method, horizontal polarization, calibration site 2 ⁶ , N5230A w/ electronic calibration kit

Parameter/Equipment	Frequency	CMC ² (±)	Comments
Hybrid Antennas –			
1 Meter Distance	(30 to 70) MHz (70 to 200) MHz (200 to 400) MHz (400 to 1000) MHz (1000 to 2000) MHz	0.5 dB 0.76 dB 0.91 dB 0.74 dB 0.75 dB	SAE ARP 958 Calibration site 1, HP 8593EM w/ electronic calibration kit
3 Meter Distance	(30 to 70) MHz (70 to 200) MHz (200 to 400) MHz (400 to 1000) MHz (1000 to 6000) MHz	0.11 dB 0.11 dB 0.19 dB 0.26 dB 0.41 dB	SAE ARP958, Appendix C calibration site 1, HP 8591E, HP 8593E, N5230A w/ electronic calibration kit
3 Meter & 10 Meter Distance	(20 to 1000) MHz (1000 to 6000) MHz	0.58 dB 0.75 dB	ANSI C63.5, Standard site method, horizontal polarization, calibration site 2 ⁶ , N5230A w/ electronic calibration kit
	(20 to 1000) MHz (1000 to 6000) MHz	0.68 dB 0.89 dB	ANSI C63.5, Identical antenna method, horizontal polarization, calibration site 2 ⁶ , N5230A w/ electronic calibration kit
Horn Antennas – LPA's			
1 Meter Distance	700 MHz to 40 GHz	0.45 dB	SAE ARP 958 Calibration site 1, N5230A w/ electronic calibration kit
3 Meter Distance	700 MHz to 40 GHz	0.48 dB	SAE ARP958, Appendix C, calibration site 1, N5230A w/ electronic calibration kit
3 Meter Distance	700 MHz to 18 GHz (18 to 26.5) GHz (26.5 to 40) GHz	0.37 dB 0.42 dB 0.47 dB	ANSI C63.5, Standard site method, horizontal polarization, calibration site 2 ⁶ , N5230A w/ electronic calibration kit

Parameter/Equipment	Frequency	CMC ^{2,4} (±)	Comments
Horn Antennas – LPA's (cont)			ANSI C63.5,
3 Meter Distance	700 MHz to 40 GHz	0.50 dB	Identical antenna method, horizontal polarization, calibration site 2 ⁶ , N5230A w/ electronic calibration kit

II. Mechanical

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Accelerometers vs. Primary Standards ⁷	(10 to 99) Hz 100 Hz (101 to 920) Hz (921 to 5000) Hz (5001 to 10 0000) Hz (10 to 15) kHz (15 to 20) kHz	1.2 % 0.79 % 1.1% 1.4 % 1.9 % 2.2 % 2.8 %	Modal Shop 9155 workstation w/ 396C10/C11 air bearing shaker
Accelerometers vs. Secondary Standards ⁷	(10 to 99) Hz 100 Hz (101 to 920) Hz (921 to 5000) Hz (5001 to 100 000) Hz (10 to 15) kHz (15 to 20) kHz	1.8 % 1.4 % 1.5 % 1.8 % 2.3 % 3.0 % 3.6 %	Modal Shop 9155 workstation w/ 396C10/C11 air bearing shaker
Surface Plates ⁸ –			
Flatness	(0 to 50) ft (0 to 72 x 144) in	240 µin 3 in	Hamar laser Wyler electronic levels
Repeat Reading Gage	(0 to 0.00002) in	18 µin	Starrett repeat-o-meter

III. Thermodynamic

Parameter/Equipment	Range	CMC ² (±)	Comments
Humidity Probe Sensor ⁸ , Fixed Points	10 % RH 35 % RH 65 % RH 80 % RH 95 % RH	1.7 % RH 1.7 % RH 1.7 % RH 1.7 % RH 1.7 % RH	Rotronics
Temperature ⁸ – Measure, Infrared, Fixed Points	35 °C 100 °C 200 °C 350 °C 500 °C	1.2 °C 1.3 °C 1.5 °C 1.9 °C 2.6 °C	Fluke 4181 IR target

¹ This laboratory offers commercial 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. Calibration and 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, M is the uncertainty contribution of the mismatch error caused by the impedance mismatch between the calibration system of the laboratory and the device under calibration.

⁵ In the statement of CMC, all percentages are to be read as percent of reading unless noted otherwise.

⁶ The ground plane of size of calibration site 2 is 50 × 80 square meters and does meet the stated requirements for antenna calibration test sites called out in CISPR 16-1-5.

⁷ These calibrations are performed only at the World Cal, Inc. facility, located at 2012 High Street, Elk Horn, IA 51531.

⁸ These calibrations are performed only at the World Cal site facility, located at 2105 Broadway St., Elk Horn, IA 51531.



Accredited Laboratory

A2LA has accredited

LIBERTY LABS, INC.

Kimballton, IA

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/NCSLI Z540-1-1994 and the requirements of ANSI/NCSLI Z540.3-2006 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 17th day of November 2015.

A handwritten signature in black ink, reading "Peter Abney".

President & CEO
For the Accreditation Council
Certificate Number 2123.01
Valid to October 31, 2017

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