



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

THE BOEING COMPANY
1420 S. Trenton St, Bldg. 15-30, MC 2R-40
Seattle, WA 98108
Nguyen Trinh Phone: 206 459 6166

CALIBRATION

Valid To: December 31, 2023

Certificate Number: 4814.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations^{1, 6}:

I. Dimensional

Parameter/Equipment	Range	CMC ^{2,3,4} (±)	Comments
Autocollimators	(>20 to 1000) arc sec (0 to 20)''	0.25'' 0.20''	Angle generator w/ gage blocks
Indexing Tables	(0 to 360)°	0.4''	Moore indexing table w/ autocollimator
Precision Digital Levels	(0 to 10)'	0.2 % + 0.05'' per meter of separation	Laser angular optics
Gage Blocks – Steel	<0.1 in (0.1 to 1.0) in (1.0 to 4.0) in (5 to 20) in	2.1 µin 1.9 µin 2.8 µin (2.6 + 0.36L) µin	Laser/mechanical comparison to NIST calibrated masters Mechanical comparison to NIST calibrated masters
Chrome Carbide	<0.05 in (0.050 to 4.0) in	3.6 µin (3.2 + 0.33L) µin	Laser/mechanical comparisons to NIST calibrated masters

Parameter/Equipment	Range	CMC ^{2, 3, 4} ($\pm$)	Comments
Plain Ring Gage –			
Diameter	(0.04 to >1.0) in (1.0 to 13.0) in	4.8 μ in 3.8 + 0.72D μ in	Ring gage comparator w/ gage blocks
Roundness	(0.04 to <2.0) in (>2.0 to $\leq$ 6.0) in (>6.0 to 11.8) in	2.2 μ in 3.3 μ in 6.7 μ in	Mitutoyo roundness machine
Laser Tracker	Radius: < 1800 in Distance: $\leq$ 70 in Distance: (> 70 to 960) in	0.001 in + 10 μ in/in 0.0002 in 3.0 μ in/in	Scale bar Laser interferometer

II. Electrical – DC/Low Frequency

Parameter/Range	Frequency	CMC ^{2, 5} ($\pm$)	Comments
AC/DC Difference for Low Frequency Detectors & Shunts			
(10 to 500) mA	10 Hz 55 Hz 400 Hz 1 kHz 10 kHz 30 kHz 70 kHz 100 kHz	75 μ A/A 50 μ A/A 40 μ A/A 40 μ A/A 40 μ A/A 40 μ A/A 60 μ A/A 75 μ A/A	Direct comparison w/ A40B shunts
(1 to 2) A	10 Hz 55 Hz 400 Hz 1 kHz 10 kHz 30 kHz 70 kHz 100 kHz	75 μ A/A 50 μ A/A 50 μ A/A 50 μ A/A 50 μ A/A 60 μ A/A 75 μ A/A 100 μ A/A	

Parameter/Range	Frequency	CMC ^{2, 5} ($\pm$)	Comments
AC/DC Difference for Low Frequency Detectors & Shunts (cont)			
3 A	10 Hz	75 μ A/A	Direct comparison w/ A40B shunts
	55 Hz	50 μ A/A	
	400 Hz	50 μ A/A	
	1 kHz	50 μ A/A	
	10 kHz	50 μ A/A	
	30 kHz	70 μ A/A	
	70 kHz	150 μ A/A	
	100 kHz	250 μ A/A	
5 A	10 Hz	75 μ A/A	
	55 Hz	50 μ A/A	
	400 Hz	50 μ A/A	
	1 kHz	50 μ A/A	
	10 kHz	50 μ A/A	
	30 kHz	75 μ A/A	
	70 kHz	300 μ A/A	
	100 kHz	350 μ A/A	
10 A	10 Hz	75 μ A/A	
	55 Hz	50 μ A/A	
	400 Hz	50 μ A/A	
	1 kHz	50 μ A/A	
	10 kHz	60 μ A/A	
	30 kHz	140 μ A/A	
	70 kHz	300 μ A/A	
20 A	10 Hz	75 μ A/A	
	55 Hz	70 μ A/A	
	400 Hz	70 μ A/A	
	1 kHz	70 μ A/A	
	10 kHz	70 μ A/A	
	30 kHz	160 μ A/A	
	70 kHz	300 μ A/A	

Parameter/Equipment	Range	CMC ^{2, 5} ($\pm$)	Comments
Resistance – Measure	1 $\mu\Omega$ to 1 m Ω	25 $\mu\Omega/\Omega$	Using MI 6010B bridge w/ 6011 & 6012 extenders
	(>1 to 10) m Ω	0.60 $\mu\Omega/\Omega$	Using MI 6010B bridge w/ 6011 extender
	(>10 to 100) m Ω	0.44 $\mu\Omega/\Omega$	
	(>0.1 to <1) Ω	0.36 $\mu\Omega/\Omega$	Using MI 6000A bridge
	1 Ω	0.30 $\mu\Omega/\Omega$	
	(>1 to 10) Ω	0.32 $\mu\Omega/\Omega$	
	(>10 to 100) Ω	0.33 $\mu\Omega/\Omega$	
	>100 Ω to 1 k Ω	0.35 $\mu\Omega/\Omega$	
	(1 to 10) k Ω	0.37 $\mu\Omega/\Omega$	
	(10 to 100) k Ω	1.1 $\mu\Omega/\Omega$	
	100 k Ω to 1 M Ω	1.5 $\mu\Omega/\Omega$	
DC Voltage – Generate	(1 to 10) M Ω	1.8 $\mu\Omega/\Omega$	Direct Comparison w/ MI 9331 resistor using MI 6652A-P high resistance meter
	(10 to 100) M Ω	2.1 $\mu\Omega/\Omega$	
	100 M Ω to 1 G Ω	12 $\mu\Omega/\Omega$	
	(1 to 10) G Ω	0.015 %	
	(10 to 100) G Ω	0.022 %	
	100 G Ω to 1 T Ω	0.080 %	
	(1 to 10) T Ω	0.085 %	
DC Voltage – Generate	10 V	0.19 $\mu\text{V}/\text{V}$	Using 3 Zener intercomparison
	10 V	0.02 $\mu\text{V}/\text{V}$	Using Array Josephson Junction System
DC Voltage – Dividers, Meters & Indicators	100 V to 100 kV	0.015 %	Comparison w/ park divider

Parameter/Range	Frequency	CMC ^{2,5} ($\pm$)	Comments
AC/DC Difference – Voltage (22 mV Range) 2 mV	10 Hz	420 μ V/V	Direct comparison w/ Fluke 792A
	20 Hz	420 μ V/V	
	40 Hz	420 μ V/V	
6 mV	100 Hz	410 μ V/V	
	1 kHz	410 μ V/V	
	10 kHz	410 μ V/V	
	20 kHz	410 μ V/V	
	50 kHz	440 μ V/V	
	100 kHz	540 μ V/V	
	300 kHz	630 μ V/V	
	500 kHz	750 μ V/V	
	800 kHz	880 μ V/V	
	1 MHz	880 μ V/V	
	10 Hz	330 μ V/V	
	20 Hz	330 μ V/V	
	40 Hz	290 μ V/V	
	100 Hz	270 μ V/V	
10 mV	1 kHz	270 μ V/V	
	10 kHz	270 μ V/V	
	20 kHz	270 μ V/V	
	50 kHz	360 μ V/V	
	100 kHz	420 μ V/V	
	300 kHz	520 μ V/V	
	500 kHz	590 μ V/V	
	800 kHz	730 μ V/V	
	1 MHz	770 μ V/V	
	10 Hz	96 μ V/V	
	20 Hz	80 μ V/V	
	40 Hz	80 μ V/V	
	100 Hz	80 μ V/V	
	1 kHz	80 μ V/V	
	10 kHz	80 μ V/V	
	20 kHz	80 μ V/V	
	50 kHz	140 μ V/V	
	100 kHz	200 μ V/V	
	300 kHz	250 μ V/V	
	500 kHz	330 μ V/V	
	800 kHz	420 μ V/V	
	1 MHz	470 μ V/V	

Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
AC/DC Difference – Voltage (cont)			
(22 mV Range) 20 mV	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	96 µV/V 80 µV/V 80 µV/V 80 µV/V 80 µV/V 80 µV/V 80 µV/V 140 µV/V 200 µV/V 250 µV/V 330 µV/V 420 µV/V 470 µV/V	Direct comparison w/ Fluke 792A
(220 mV Range) 20 mV	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	94 µV/V 77 µV/V 77 µV/V 75 µV/V 75 µV/V 75 µV/V 75 µV/V 110 µV/V 170 µV/V 270 µV/V 340 µV/V 420 µV/V 470 µV/V	
60 mV	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	70 µV/V 51 µV/V 45 µV/V 41 µV/V 41 µV/V 35 µV/V 35 µV/V 53 µV/V 95 µV/V 170 µV/V 250 µV/V 380 µV/V 380 µV/V	

Parameter/Range	Frequency	CMC ^{2, 5} (±)	Comments
AC/DC Difference – Voltage (cont)			
(220 mV Range) 100 mV	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	51 µV/V 45 µV/V 39 µV/V 33 µV/V 21 µV/V 21 µV/V 27 µV/V 27 µV/V 50 µV/V 94 µV/V 130 µV/V 290 µV/V 290 µV/V	Direct comparison w/ Fluke 792A
200 mV	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	33 µV/V 28 µV/V 17 µV/V 16 µV/V 16 µV/V 16 µV/V 17 µV/V 26 µV/V 44 µV/V 94 µV/V 130 µV/V 270 µV/V 290 µV/V	
(700 mV Range) 200 mV	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	34 µV/V 28 µV/V 18 µV/V 16 µV/V 16 µV/V 16 µV/V 17 µV/V 26 µV/V 44 µV/V 94 µV/V 130 µV/V 270 µV/V 290 µV/V	

Parameter/Range	Frequency	CMC ^{2, 5} ($\pm$)	Comments
AC/DC Difference – Voltage (cont)			
(700 mV Range) 600 mV	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	32 μ V/V 24 μ V/V 23 μ V/V 10 μ V/V 9 μ V/V 9 μ V/V 10 μ V/V 10 μ V/V 14 μ V/V 32 μ V/V 38 μ V/V 62 μ V/V 74 μ V/V	Direct comparison w/ Fluke 792A
(2.2 V Range) 600 mV	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	32 μ V/V 26 μ V/V 22 μ V/V 10 μ V/V 8 μ V/V 8 μ V/V 9 μ V/V 11 μ V/V 12 μ V/V 28 μ V/V 32 μ V/V 44 μ V/V 54 μ V/V	
1.0 V	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	32 μ V/V 26 μ V/V 22 μ V/V 10 μ V/V 8 μ V/V 8 μ V/V 8 μ V/V 10 μ V/V 15 μ V/V 27 μ V/V 33 μ V/V 45 μ V/V 54 μ V/V	

Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
AC/DC Difference – Voltage (cont)			
(2.2 V Range) 2.0 V	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	32 µV/V 26 µV/V 22 µV/V 10 µV/V 8 µV/V 8 µV/V 8 µV/V 8 µV/V 10 µV/V 27 µV/V 33 µV/V 45 µV/V 54 µV/V	Direct comparison w/ Fluke 792A
(7 V Range) 2.0 V	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	32 µV/V 26 µV/V 22 µV/V 10 µV/V 8 µV/V 8 µV/V 8 µV/V 9 µV/V 10 µV/V 26 µV/V 32 µV/V 38 µV/V 50 µV/V	
6.0 V	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	32 µV/V 26 µV/V 22 µV/V 10 µV/V 8 µV/V 8 µV/V 8 µV/V 9 µV/V 10 µV/V 26 µV/V 32 µV/V 38 µV/V 50 µV/V	

Parameter/Range	Frequency	CMC ^{2, 5} ($\pm$)	Comments
AC/DC Difference – Voltage (cont)			
(22 V Range) 6.0 V	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	32 μ V/V 27 μ V/V 23 μ V/V 10 μ V/V 8 μ V/V 8 μ V/V 8 μ V/V 10 μ V/V 10 μ V/V 27 μ V/V 33 μ V/V 50 μ V/V 59 μ V/V	Direct comparison w/ Fluke 792A
10 V	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	32 μ V/V 26 μ V/V 22 μ V/V 10 μ V/V 8 μ V/V 8 μ V/V 8 μ V/V 9 μ V/V 11 μ V/V 26 μ V/V 32 μ V/V 50 μ V/V 59 μ V/V	
20 V	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	32 μ V/V 26 μ V/V 22 μ V/V 10 μ V/V 9 μ V/V 9 μ V/V 9 μ V/V 10 μ V/V 12 μ V/V 26 μ V/V 32 μ V/V 50 μ V/V 59 μ V/V	

Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
AC/DC Difference – Voltage (cont)			
(70 V Range) 20 V	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz	32 µV/V 26 µV/V 22 µV/V 10 µV/V 9 µV/V 9 µV/V 9 µV/V 10 µV/V 14 µV/V 65 µV/V	Direct comparison w/ Fluke 792A
60 V	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz	33 µV/V 27 µV/V 26 µV/V 10 µV/V 9 µV/V 9 µV/V 9 µV/V 11 µV/V 14 µV/V 32 µV/V	
(220 V Range) 60 V	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz	32 µV/V 26 µV/V 23 µV/V 10 µV/V 9 µV/V 9 µV/V 9 µV/V 17 µV/V 20 µV/V 34 µV/V	

Parameter/Range	Frequency	CMC ^{2, 5} (±)	Comments
AC/DC Difference – Voltage (cont)			
(220 V Range) 100 V	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz	32 µV/V 26 µV/V 23 µV/V 10 µV/V 9 µV/V 9 µV/V 10 µV/V 15 µV/V 17 µV/V	Direct comparison w/ Fluke 792A
200 V	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz	45 µV/V 27 µV/V 24 µV/V 12 µV/V 11 µV/V 11 µV/V 11 µV/V 17 µV/V 22 µV/V	
(1000 V Range) 200 V	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz	50 µV/V 27 µV/V 24 µV/V 15 µV/V 14 µV/V 14 µV/V 14 µV/V 21 µV/V 40 µV/V	
600 V	40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz	27 µV/V 21 µV/V 15 µV/V 15 µV/V 15 µV/V 21 µV/V 44 µV/V	
1000 V	40 Hz 100 Hz 1 kHz 10 kHz 20 kHz	27 µV/V 24 µV/V 22 µV/V 22 µV/V 23 µV/V	

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
AC High Voltage – Dividers, Meters & Indicators	100 V to 69 kV	0.03 %	Direct comparison w/ Westinghouse APT 350 (60 Hz)

Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
Capacitance – Generate & Measure			
1 pF	50 Hz 100 Hz 1 kHz 10 kHz 20 kHz	45 µF/F 15 µF/F 6 µF/F 22 µF/F 75 µF/F	Direct comparison w/ fused silica standards AH 11A
10 pF	50 Hz 100 Hz 1 kHz 10 kHz 20 kHz	12 µF/F 6 µF/F 2 µF/F 5 µF/F 15 µF/F	
100 pF	50 Hz 100 Hz 1 kHz 10 kHz 20 kHz	12 µF/F 6 µF/F 2 µF/F 5 µF/F 10 µF/F	
1000 pF	1 kHz	6 µF/F	Direct measurement using capacitance bridge AH 2500 bridge

Parameter/Range	Frequency	CMC ^{2, 5} (±)	Comments
Inductance – Generate & Measure			
100 µH	100 Hz	0.40 %	Direct comparison w/ primary 1482 series inductors
	1 kHz	0.15 %	
	10 kHz	0.15 %	
	20 kHz	0.90 %	
1 mH	100 Hz	0.05 %	
	1 kHz	0.05 %	
	10 kHz	0.05 %	
	20 kHz	0.10 %	
10 mH	100 Hz	0.05 %	
	1 kHz	0.05 %	
	10 kHz	0.05 %	
100 mH	100 Hz	0.05 %	
	1 kHz	0.05 %	
	10 kHz	0.05 %	
200 mH	100 Hz	0.05 %	
	1 kHz	0.05 %	
	10 kHz	0.20 %	
1 H	100 Hz	0.05 %	
	1 kHz	0.08 %	
	10 kHz	0.25 %	
2 H	100 Hz	0.05 %	
	1 kHz	0.05 %	
5 H	100 Hz	0.05 %	
	1 kHz	0.05 %	
10 H	100 Hz	0.05 %	
	1 kHz	0.05 %	

III. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
Absolute Tuned RF Level – 1 MHz to 50 GHz	(10 to -120) dBm	0.40 dB	Agilent N5531S
Power Sensor Cal Factor – 100 kHz to 10 GHz (10 to 18) GHz (18 to 26.5) GHz (1 to 18) GHz (18 to 26.5) GHz	10 µW to 100 mW 10 µW to 100 mW 10 µW to 100 mW 100 pW to 10 µW 100 pW to 10 µW	1.9 % 3.2 % 4.7 % 3.1 % 5.3 %	Tegam 1130B & 1135B power standards
Phase Noise – 100 MHz to 26.5 GHz 100 MHz to 26.5 GHz	<1 MHz offsets ≤100 MHz offsets	2.4 dB 4.7 dB	Keysight technologies N5500A/N5507A
Oscillator – AM Measure (Carrier F) 100 kHz to 10 MHz (10 to 3000) MHz (10 to 3000) MHz (3 to 26.5) (3 to 26.5) (26.5 to 31.15) GHz	Rate/Depth 50 Hz to 10 kHz 5 % to 99 % 50 Hz to 100 kHz 20 % to 99 % 50 Hz to 100 kHz 5 % to 20 % 50 Hz to 100 kHz 20 % to 99 % 50 Hz to 100 kHz 5 % to 20 % 50 Hz to 100 kHz 20 % to 99 %	0.9 % 0.6 % 2.9 % 1.7 % 5.2 % 2.2 %	Agilent N5531S measuring receiver

Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
Oscillator – (cont)			
AM Measure (Carrier F) (26.5 to 31.15) GHz	50 Hz to 100 kHz 5 % to 20 %	7.9 %	Agilent N5531S measuring receiver
(31.15 to 50) GHz	50 Hz to 100 kHz 20 % to 99 %	6.9 %	
(31.15 to 50) GHz	50 Hz to 100 kHz 5 % to 20 %	30 %	
FM Measure (Carrier F) 250 kHz to 10 MHz	Rate/Peak Deviation: 20 Hz to 10 kHz/ $\beta > 0.2$ 200 Hz to 40 kHz/ $\beta > 1.2$	1.7 % 1.2 %	B is the ratio frequency deviation to modulation rate (deviation/rate)
10 MHz to 6.6 GHz	50 Hz to 200 kHz/ $\beta > 0.2$ 250 Hz to 400 kHz/ $\beta > 0.45$	1.7 % 1.2 %	
(6.6 to 13.2) GHz	50 Hz to 200 kHz/ $\beta > 0.2$ 250 Hz to 400 kHz/ $\beta > 8$	2.9 % 1.2 %	
(13.2 to 31.15) GHz	50 Hz to 200 kHz/ $\beta > 0.2$ 250 Hz to 400 kHz/ $\beta > 16$	4.4 % 1.2 %	
(31.15 to 50) GHz	50 Hz to 200 kHz/ $\beta > 0.2$ 250 Hz to 400 kHz/ $\beta > 32$	9.8 % 1.2 %	
PM Measure (Carrier F) 100 kHz to 6.6 GHz	Deviation in Radians: >0.7 >0.3	1.2 % 3.5 %	
(6.6 to 13.2) GHz	>2.0 >0.6	1.2 % 3.5 %	
(13.2 to 26.5) GHz	>4.0 >1.2	1.2 % 3.5 %	The upper limit of deviation range is determined by a combination of a carrier frequency & bandwidth settings
(26.5 to 31.5) GHz	>4.0 >1.3	1.2 % 3.5 %	
(31.5 to 50) GHz	>8.0 >2.4	1.2 % 3.5 %	

Parameter/Range	Frequency	CMC ^{2, 5} ($\pm$)	Comments
Oscillator – (cont) Total Harmonic Distortion 20 Hz to 250 kHz Spectral Purity Amplitude Accuracy 100 kHz to 3 GHz (>3 to 6.6) GHz (>6.6 to 31.15) GHz (31.15 to 50) GHz	-80 dB to 0 dB 0.01 % to 100 % Minimum Power Level -140 dB -146 dB -136 dB -123 dB	1.2 dB 1.8 dB 2.4 dB 3.0 dB 3.1 dB	Agilent E4448A spectrum analyzer
Transmission S_{12}/S_{21} – 300 kHz to 500 MHz	(0 to 20) dB (20 to 50) dB (50 to 70) dB (0 to 20) dB (20 to 50) dB (50 to 70) dB (0 to 20) dB (20 to 50) dB (50 to 70) dB (0 to 20) dB (20 to 50) dB (50 to 70) dB	(Mag (dB)/Phase (deg)) 0.09 dB/0.12° 0.1 dB/0.14° 0.15 dB/0.23° 0.02 dB/0.25° 0.03 dB/0.35° 0.15 dB/0.80° 0.02 dB/0.25° 0.02 dB/0.30° 0.07 dB/1.0° 0.09 dB/0.25° 0.10 dB/1.3° 0.15 dB/2.0°	VNA & 7 mm cal kit VNA & 7 mm (TRL) cal kit VNA & 3.5 mm (TRL) cal kit VNA & 2.4 mm (SL) cal kit
Reflection S_{11}/S_{22} – 300 kHz to 1.3 GHz (1.3 to 3) GHz (3 to 6) GHz (0.045 to 2) GHz (2 to 8) GHz (8 to 18) GHz (0.045 to 2) GHz (2 to 8) GHz 8 GHz to 26.5 Hz	(Lin Mag/Phase) (0 to 1)/(-180 to 180)° (0.045 to 2) GHz (2 to 8) GHz (8 to 18) GHz (0.045 to 2) GHz (2 to 8) GHz 8 GHz to 26.5 Hz	(Lin Mag/Phase) 0.002/0.6° 0.003/0.5° 0.005/0.7° 0.002/0.4° 0.002/0.4° 0.002/0.5° 0.004/0.7° 0.005/0.7° 0.006/1.0°	VNA & 7 mm cal kit VNA & 7 mm TRL cal kit VNA & 3.5 mm cal kit

Parameter/Range	Frequency	CMC ^{2, 5} ($\pm$)	Comments
Reflection S_{11}/S_{22} – (cont) (0.045 to 2) GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	(Lin Mag/Phase) (0 to 1)/(-180 to 180) $^{\circ}$	(Lin Mag/Phase) 0.008/1.3 $^{\circ}$ 0.008/1.3 $^{\circ}$ 0.012/3.0 $^{\circ}$ 0.015/3.5 $^{\circ}$	VNA & 2.4 mm cal kit

IV. Mechanical

Parameter/Equipment	Range	CMC ^{2, 4} ($\pm$)	Comments
Force – Measure & Measuring Equipment	(2 to 50 000) lbf (50 000 to 200 000) lbf	0.01 % 0.025 %	Deadweight NIST calibrated load cell
Vacuum & Low – Pressure Gauges (Pneumatic)	Gauge Pressure: (4 to 350) kPa (40 to 8000) kPa Absolute Pressure: (7 to 380) kPa (100 to 7600) kPa	0.0012 % + 0.20 Pa 0.002 % + 1.2 Pa 0.0012 % + 0.10 Pa 0.002 % + 2.0 Pa	Automated mass handler: Low Piston High Piston Low Piston High Piston

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Mass – Measure	50 kg 30 kg 25 kg 20 kg 10 kg 5 kg 3 kg 2 kg 1 kg 500 g 300 g 200 g 100 g 50 g 30 g 20 g 10 g 5 g 3 g 2 g 1 g 500 mg 300 mg 200 mg 100 mg 50 mg 30 mg 20 mg 10 mg 5 mg 3 mg 2 mg 1 mg	38 mg 16 mg 7.8 mg 5.0 mg 0.8 mg 1.2 mg 0.88 mg 0.72 mg 0.07 mg 0.058 mg 0.054 mg 0.053 mg 0.014 mg 0.009 mg 0.008 mg 0.007 mg 0.007 mg 0.0025 mg 0.0017 mg 0.0014 mg 0.0012 mg 0.0012 mg 0.0012 mg 0.0012 mg 0.0012 mg 0.0013 mg 0.0012 mg 0.0012 mg 0.0012 mg 0.0012 mg 0.0012 mg 0.0012 mg 0.0012 mg	Double substitution method Echelon II and III

Parameter/Equipment	Range	CMC ² (±)	Comments
Avoirdupois	300 lb	250 mg	Double substitution method Echelon II and III
	200 lb	200 mg	
	150 lb	175 mg	
	100 lb	48.5 mg	
	50 lb	8.5 mg	
	30 lb	4.2 mg	
	20 lb	2.5 mg	
	10 lb	1.4 mg	
	5 lb	1.1 mg	
	3 lb	0.55 mg	
	2 lb	0.090 mg	
	1 lb	0.082 mg	
	8 oz	0.082 mg	
	4 oz	0.071 mg	
	2 oz	0.012 mg	
	1 oz	0.011 mg	
	½ oz	0.011 mg	
	¼ oz	0.011 mg	
	1/8 oz	0.002 mg	
	1/16 oz	0.002 mg	
	1/32 oz	0.002 mg	

V. Thermodynamics

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Relative Humidity – Measuring Equipment	(10 to 90) % RH	1.0 % RH	Thunder Scientific 2500 (0 to 70) °C
Dew Point – Measure & Measuring Equipment	(-65 to -15) °C	0.40 °C	Chilled mirror sensor at (17 to 23) °C
Temperature – Measuring Equipment	(-100 to 300) °C	0.02 °C	SPRT using liquid bath

VI. Time & Frequency

Parameter/Equipment	Range	CMC ² (±)	Comments
Frequency Stability (Time Base Accuracy)	10 MHz	1 part in 10 ⁻¹¹ Hz	GPS

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 In the statement of CMC, percentages are percentage of reading, unless otherwise indicated; L is the numerical value of the nominal length of the device measured in inches; D is the diameter of the device in inches.

⁴ 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.

⁵ The stated measured values are determined using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure or generate the measured value in the ranges indicated. CMCs are expressed as either a specific value that covers the full range or as a percent or fraction of the reading plus a fixed floor specification.

⁶ This scope meets A2LA's P112 *Flexible Scope Policy*.



Accredited Laboratory

A2LA has accredited

THE BOEING COMPANY

Seattle, WA

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 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 4th day of May 2022.

A blue ink signature of the Vice President of Accreditation Services.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 4814.01
Valid to December 31, 2023

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