SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017
& ANSI/NCSL Z540-1-1994

U.S. ARMY PRIMARY STANDARDS LABORATORY
AMAM-TMS Buildings 5435 and 5417
Redstone Arsenal, AL 35898-5000
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CALIBRATION

Valid To: December 31, 2024 Certificate Number: 1256.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations[1, 11]:

I. Acoustical Quantities

Parameter/Equipment	Range	CMC[2] (±)	Comments
Microphone Sensors			
(-100 to -10) dB	50 Hz to 1 kHz (>1 to 6) kHz (>6 to 25) kHz	0.10 dB 0.15 dB 0.30 dB	Type L pressure reciprocity
	250 Hz	0.16 dB	Voltage insertion
	2 Hz to 100 kHz (>100 to 200) kHz	0.50 dB 0.70 dB	Electrostatic actuator
Sound Calibrators			
(70 to 130) dB	125 Hz to 4 kHz	0.30 dB	Comparison to APSL calibrated standard sound calibrator
	20 Hz to 25 kHz	0.11 dB	Voltage insertion

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II. Dimensional

Parameter/Equipment	Range	CMC[2, 4, 10] (±)	Comments
Gage Blocks	(0.01 to 0.120) in (>0.120 to <1) in (1 to <5) in (5 to 20) in	4 µin 3.3 µin (3.2 + 0.22*L*) µin (0.5 + 1.0*L*) µin	Mechanical comparison
Thread Wires	(4 to 80) TPI (60° in) (1 to 20) TPI (29° in) (10 to 0.2) pitch (mm)	(5.5 + 3.8*D*) µin 8.0 µin	Laser micrometer Mechanical comparison
Cylinders & Gear Wires	Up to 2 in	(5 + 4.4*D*) µin 8.0 µin	Laser micrometer Mechanical comparison
Precision Spheres	Up to 1 in	(7 + 3.8*D*) µin 8.5 µin	Laser micrometer Mechanical comparison
Internal Diameter: Fixed Points – Measure	1.85 mm 2.4 mm 2.92 mm 3.5 mm 7.0 mm 0.0728 in 0.0945 in 0.1150 in 0.1378 in 0.2756 in	(0.62 + 5*D*) µm (25 + 5*D*) µin	Air gauging (*D* is the diameter of the unit under test in m or in, respectively
External Diameter – Measure	(0.9838 to 0.9842) in (1.1992 to 1.1996) in (1.2006 to 1.2008) in (1.4788 to 1.4790) in	(25 + 5*D*) µin	Air gauging

Parameter/Equipment	Range	CMC[2, 4, 10] (±)	Comments
Internal Diameter – Measure	(0.2725 to 0.5) in (>0.5 to 1.5) in (1.5 to 10) in	(33 + 1.5*D*) µin 12 µin (10 + 0.82*D*) µin	Mechanical comparison
3-Dimensional Length – Measure 1 D 2 D 3 D	 Up to 40 in (40 x 36) in (40 x 36 x 24) in	 (22 + 2.3*L*) µin	 Leitz PMM-C Infinity CMM
Angle Blocks	Up to 45°	1.0 arcsec	Autocollimator; comparison to master angle block
Angle Measurements – Measure	± 1000 arcsec	0.5 arcsec + 0.24 % 0.7 arcsec + 0.24 % 1.0 arcsec	HP 5528A laser measurement system with angular optic Angle generator Autocollimator
Flatness – Measure	Up to 10 in diameter	3.2 µin	Interferometer, Master optical flat
Autocollimators	≤60 arcsec (>60 to 1000) arcsec	0.60 arcsec 0.7 arcsec + 0.24 %	Optical wedges Angle generator
Length Gages/Encoders	Up to 1 in	10 µin	Gage blocks

III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC[2, 4, 12] (±)	Comments
DC Voltage – Generate, Fixed Points	1.018 V 10 V	0.070 µV/V 0.050 µV/V	Fluke 732B
	(0.002 to <0.006) V (0.006 to <0.02) V (0.02 to <0.06) V (0.06 to <0.1) V (0.1 to <0.2) V (0.2 to <1) V (1 to <2) V (2 to <60) V (60 to 1000) V	180 µV/V 60 µV/V 18 µV/V 6.3 µV/V 3.9 µV/V 2.3 µV/V 1.6 µV/V 1.0 µV/V 1.4 µV/V	MI 8000/8001 binary voltage divider & Fluke 57X0A calibrator
DC Voltage – Measure	(0 to 10) V	48 nV	Josephson Voltage System (JVS)
	(10 to 200) V (200 to 1000) V	250 nV/V 800 nV/V	MI 8000/8001 binary voltage divider
Fixed Points	100 V 1000 V	240 nV/V 580 nV/V	Fluke 732B with voltage divider & nullmeter
DC Resistance – Measure	(1 to <10) µΩ (10 to <100) µΩ	0.031 % 0.027 %	MI 6010-2000 system
	100 µΩ to <1 mΩ (1 to <10) mΩ (10 to <100) mΩ 100 mΩ to <1 Ω (1 to <10) Ω (10 to <100) Ω 100 Ω to <1 kΩ (1 to <10) kΩ	6.2 µΩ/Ω 5.1 µΩ/Ω 3.5 µΩ/Ω 0.49 µΩ/Ω 0.23 µΩ/Ω 0.23 µΩ/Ω 0.21 µΩ/Ω 0.23 µΩ/Ω	MI 6010C direct current comparator bridge, MI 6011 range extenders
	(10 to <100) kΩ 100 kΩ to <1 MΩ (1 to <10) MΩ (10 to <100) MΩ 100 MΩ to <1 GΩ 1 GΩ	0.25 µΩ/Ω 1.5 µΩ/Ω 3.9 µΩ/Ω 10 µΩ/Ω 15 µΩ/Ω 30 µΩ/Ω	MI 6000B binary voltage divider bridge

Parameter/Equipment	Range	CMC[2, 4, 12] (±)	Comments
High Value Resistance – Measure, Fixed Points	10 MΩ 100 MΩ 1 GΩ 10 GΩ 100 GΩ 1 TΩ	25 μΩ/Ω 15 μΩ/Ω 15 μΩ/Ω 50 μΩ/Ω 0.049 % 0.037 %	Bridge ratio method with NIST calibrated standards
Inductance – Measure, at 1 kHz	50 μH 100 μH 200 μH 500 μH (1 to 200) mH (0.5 to 2) H (5 to 10) H	0.31 % 0.18 % 0.13 % 0.044 % 0.035 % 0.056 % 0.21 %	Comparison with reference standards using IET RLC Digibridge
Capacitance – Measure, Fixed Points, at 1 kHz	10 pF 100 pF 1000 pF	3.5 μF/F 3.5 μF/F 3.6 μF/F	Andeen-Hagerling 2500A bridge plus 10 pf & 100 pF silicon capacitors Andeen-Hagerling 2500A bridge plus 100 pF silicon capacitors
VOR Bearing Angle – Measure	(0 to 330)°	0.013°	Comparison with NIST VOR standard using NIST system

Parameter/Range	Frequency	CMC[2, 12] (±)	Comments
AC Ratio – Measure, Fixed Points	400 Hz 1 kHz	1.1 parts in 10^6 1.1 parts in 10^6	Comparison to NIST calibrated DT72A inductive volt divider using ratio techniques

Parameter/Range	Frequency	CMC[2, 12] (±)	Comments
AC/DC Difference – Current Shunts, Fixed Quantities, Measure			
1 mA	10 Hz 20 Hz 40 Hz 100 Hz 400 Hz 1 kHz 5 kHz 10 kHz 20 kHz 50 kHz 100 kHz	90 µA/A 70 µA/A 60 µA/A 60 µA/A 60 µA/A 60 µA/A 90 µA/A 100 µA/A 110 µA/A 150 µA/A 250 µA/A	Fluke A40B current shunts
10 mA	10 Hz 20 Hz 40 Hz 100 Hz 400 Hz 1 kHz 5 kHz 10 kHz 20 kHz 50 kHz 100 kHz	40 µA/A 40 µA/A 30 µA/A 30 µA/A 30 µA/A 30 µA/A 30 µA/A 30 µA/A 30 µA/A 30 µA/A 60 µA/A	
20 mA	10 Hz 20 Hz 40 Hz 100 Hz 400 Hz 1 kHz 5 kHz 10 kHz 20 kHz 50 kHz 100 kHz	40 µA/A 40 µA/A 40 µA/A 40 µA/A 30 µA/A 30 µA/A 30 µA/A 30 µA/A 30 µA/A 30 µA/A 55 µA/A	

Parameter/Range	Frequency	CMC[2, 12] (±)	Comments
AC/DC Difference – Current Shunts, Fixed Quantities, Measure (cont)			
50 mA	10 Hz 20 Hz 40 Hz 100 Hz 400 Hz 1 kHz 5 kHz 10 kHz 20 kHz 50 kHz 100 kHz	45 µA/A 45 µA/A 25 µA/A 25 µA/A 25 µA/A 25 µA/A 25 µA/A 30 µA/A 40 µA/A 50 µA/A 50 µA/A	Fluke A40B current shunts
100 mA	10 Hz 20 Hz 40 Hz 100 Hz 400 Hz 1 kHz 5 kHz 10 kHz 20 kHz 50 kHz 100 kHz	50 µA/A 40 µA/A 25 µA/A 25 µA/A 25 µA/A 25 µA/A 25 µA/A 25 µA/A 25 µA/A 40 µA/A 40 µA/A	
200 mA	10 Hz 20 Hz 40 Hz 100 Hz 400 Hz 1 kHz 5 kHz 10 kHz 20 kHz 50 kHz 100 kHz	40 µA/A 40 µA/A 25 µA/A 25 µA/A 25 µA/A 25 µA/A 25 µA/A 25 µA/A 25 µA/A 40 µA/A 45 µA/A	

Parameter/Range	Frequency	CMC[2, 12] (±)	Comments
AC/DC Difference – Current Shunts, Fixed Quantities, Measure (cont)			
500 mA	10 Hz 20 Hz 40 Hz 100 Hz 400 Hz 1 kHz 5 kHz 10 kHz 20 kHz 50 kHz 100 kHz	45 µA/A 40 µA/A 30 µA/A 25 µA/A 25 µA/A 25 µA/A 25 µA/A 25 µA/A 25 µA/A 35 µA/A 45 µA/A	Fluke A40B current shunts
1 A	10 Hz 20 Hz 40 Hz 100 Hz 400 Hz 1 kHz 5 kHz 10 kHz 20 kHz 50 kHz 100 kHz	50 µA/A 40 µA/A 30 µA/A 30 µA/A 25 µA/A 25 µA/A 25 µA/A 25 µA/A 25 µA/A 40 µA/A 45 µA/A	
2 A	10 Hz 20 Hz 40 Hz 100 Hz 400 Hz 1 kHz 5 kHz 10 kHz 20 kHz 50 kHz 100 kHz	50 µA/A 50 µA/A 35 µA/A 35 µA/A 30 µA/A 30 µA/A 30 µA/A 35 µA/A 35 µA/A 55 µA/A 55 µA/A	

Parameter/Range	Frequency	CMC[2, 12] (±)	Comments
AC/DC Difference – Current Shunts, Fixed Quantities, Measure (cont)			
5 A	10 Hz 20 Hz 40 Hz 100 Hz 400 Hz 1 kHz 5 kHz 10 kHz 20 kHz 50 kHz 100 kHz	70 µA/A 60 µA/A 40 µA/A 40 µA/A 35 µA/A 35 µA/A 35 µA/A 40 µA/A 40 µA/A 65 µA/A 120 µA/A	Fluke A40B current shunts
10 A	10 Hz 20 Hz 40 Hz 100 Hz 400 Hz 1 kHz 5 kHz 10 kHz 20 kHz 50 kHz 100 kHz	95 µA/A 75 µA/A 45 µA/A 45 µA/A 45 µA/A 45 µA/A 45 µA/A 55 µA/A 55 µA/A 90 µA/A 160 µA/A	
20 A	10 Hz 20 Hz 40 Hz 100 Hz 400 Hz 1 kHz 5 kHz 10 kHz 20 kHz 50 kHz 100 kHz	110 µA/A 85 µA/A 60 µA/A 60 µA/A 60 µA/A 60 µA/A 60 µA/A 65 µA/A 75 µA/A 120 µA/A 160 µA/A	

Parameter/Range	Frequency	CMC[2, 4, 12] (±)	Comments
AC/DC Difference – Current Shunts, Fixed Quantities, Measure (cont)			
50 A	10 Hz 20 Hz 40 Hz 100 Hz 400 Hz 1 kHz 5 kHz 10 kHz 20 kHz 50 kHz 100 kHz	140 µA/A 110 µA/A 95 µA/A 70 µA/A 70 µA/A 70 µA/A 70 µA/A 70 µA/A 90 µA/A 190 µA/A 230 µA/A	Fluke A40B current shunts
100 A	10 Hz 20 Hz 40 Hz 100 Hz 400 Hz 1 kHz 5 kHz 10 kHz 20 kHz 50 kHz 100 kHz	190 µA/A 140 µA/A 110 µA/A 95 µA/A 95 µA/A 95 µA/A 100 µA/A 140 µA/A 150 µA/A 250 µA/A 320 µA/A	
AC/DC Difference, Voltage – Measure, Fixed Points			
2 mV	10 Hz 20 Hz 40 Hz 50 Hz 100 Hz 400 Hz 1 kHz 3 kHz 10 kHz 20 kHz 30 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	130 µV/V 130 µV/V 130 µV/V 130 µV/V 80 µV/V 80 µV/V 80 µV/V 70 µV/V 70 µV/V 70 µV/V 70 µV/V 70 µV/V 70 µV/V 120 µV/V 200 µV/V 240 µV/V 240 µV/V	Fluke 792A AC/DC transfer standard

Parameter/Range	Frequency	CMC[2, 12] (±)	Comments
AC/DC Difference, Voltage – Measure, Fixed Points (cont)			
6 mV	10 Hz	65 µV/V	Fluke 792A AC/DC transfer standard
	20 Hz	65 µV/V	
	40 Hz	65 µV/V	
	50 Hz	65 µV/V	
	100 Hz	65 µV/V	
	400 Hz	65 µV/V	
	1 kHz	65 µV/V	
	3 kHz	50 µV/V	
	10 kHz	50 µV/V	
	20 kHz	50 µV/V	
	30 kHz	50 µV/V	
	50 kHz	50 µV/V	
	100 kHz	50 µV/V	
	300 kHz	60 µV/V	
	500 kHz	110 µV/V	
	800 kHz	130 µV/V	
	1 MHz	230 µV/V	
10 mV	10 Hz	40 µV/V	
	20 Hz	40 µV/V	
	40 Hz	40 µV/V	
	50 Hz	40 µV/V	
	100 Hz	40 µV/V	
	400 Hz	40 µV/V	
	1 kHz	40 µV/V	
	3 kHz	40 µV/V	
	10 kHz	40 µV/V	
	20 kHz	40 µV/V	
	30 kHz	45 µV/V	
	50 kHz	45 µV/V	
	100 kHz	60 µV/V	
	300 kHz	65 µV/V	
	500 kHz	120 µV/V	
	800 kHz	140 µV/V	
	1 MHz	140 µV/V	

Parameter/Range	Frequency	CMC[2, 12] (±)	Comments
AC/DC Difference, Voltage – Measure, Fixed Points (cont)			
20 mV	10 Hz	30 µV/V	Fluke 792A AC/DC transfer standard
	20 Hz	30 µV/V	
	40 Hz	30 µV/V	
	50 Hz	30 µV/V	
	100 Hz	30 µV/V	
	400 Hz	30 µV/V	
	1 kHz	30 µV/V	
	3 kHz	18 µV/V	
	10 kHz	18 µV/V	
	20 kHz	18 µV/V	
	30 kHz	18 µV/V	
	50 kHz	26 µV/V	
	100 kHz	50 µV/V	
	300 kHz	50 µV/V	
	500 kHz	100 µV/V	
	800 kHz	140 µV/V	
	1 MHz	190 µV/V	
60 mV	10 Hz	18 µV/V	
	20 Hz	18 µV/V	
	40 Hz	18 µV/V	
	50 Hz	18 µV/V	
	100 Hz	18 µV/V	
	400 Hz	14 µV/V	
	1 kHz	14 µV/V	
	3 kHz	14 µV/V	
	10 kHz	20 µV/V	
	20 kHz	20 µV/V	
	30 kHz	20 µV/V	
	50 kHz	20 µV/V	
	100 kHz	40 µV/V	
	300 kHz	55 µV/V	
	500 kHz	90 µV/V	
	800 kHz	120 µV/V	
	1 MHz	120 µV/V	

Parameter/Range	Frequency	CMC[2, 12] (±)	Comments
AC/DC Difference, Voltage – Measure, Fixed Points (cont)			
100 mV	10 Hz 20 Hz 40 Hz 50 Hz 100 Hz 400 Hz 1 kHz 3 kHz 10 kHz 20 kHz 30 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	10 µV/V 8 µV/V 8 µV/V 8 µV/V 8 µV/V 8 µV/V 8 µV/V 8 µV/V 10 µV/V 12 µV/V 12 µV/V 12 µV/V 24 µV/V 24 µV/V 24 µV/V 32 µV/V 45 µV/V	Fluke 792A AC/DC transfer standard
200 mV	10 Hz 20 Hz 40 Hz 50 Hz 100 Hz 400 Hz 1 kHz 3 kHz 10 kHz 20 kHz 30 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	8 µV/V 8 µV/V 8 µV/V 8 µV/V 8 µV/V 8 µV/V 8 µV/V 8 µV/V 8 µV/V 8 µV/V 8 µV/V 8 µV/V 12 µV/V 16 µV/V 16 µV/V 22 µV/V 35 µV/V 40 µV/V	

Parameter/Range	Frequency	CMC[2, 12] (±)	Comments
AC/DC Difference, Voltage – Measure, Fixed Points (cont)			
500 mV	10 Hz 20 Hz 40 Hz 50 Hz 100 Hz 400 Hz 1 kHz 3 kHz 10 kHz 20 kHz 30 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	18 µV/V 18 µV/V 12 µV/V 12 µV/V 10 µV/V 10 µV/V 10 µV/V 10 µV/V 10 µV/V 12 µV/V 14 µV/V 20 µV/V 35 µV/V 40 µV/V 40 µV/V 40 µV/V 40 µV/V	Fluke 792A AC/DC transfer standard
600 mV	10 Hz 20 Hz 40 Hz 50 Hz 100 Hz 400 Hz 1 kHz 3 kHz 10 kHz 20 kHz 30 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	12 µV/V 10 µV/V 10 µV/V 10 µV/V 10 µV/V 10 µV/V 10 µV/V 10 µV/V 10 µV/V 10 µV/V 10 µV/V 10 µV/V 14 µV/V 14 µV/V 14 µV/V 20 µV/V 26 µV/V	
1 V	10 Hz 20 Hz 40 Hz 50 Hz 100 Hz 400 Hz 1 kHz 3 kHz 10 kHz 20 kHz	6 µV/V 6 µV/V 6 µV/V 6 µV/V 6 µV/V 6 µV/V 6 µV/V 6 µV/V 6 µV/V 6 µV/V	

Parameter/Range	Frequency	CMC[2, 12] (±)	Comments
AC/DC Difference, Voltage – Measure, Fixed Points (cont)			
1 V	30 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	6 µV/V 6 µV/V 8 µV/V 10 µV/V 12 µV/V 20 µV/V 24 µV/V	Fluke 792A AC/DC transfer standard
2 V	10 Hz 20 Hz 40 Hz 50 Hz 100 Hz 400 Hz 1 kHz 3 kHz 10 kHz 20 kHz 30 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	8 µV/V 6 µV/V 6 µV/V 6 µV/V 6 µV/V 4 µV/V 4 µV/V 4 µV/V 4 µV/V 4 µV/V 4 µV/V 4 µV/V 8 µV/V 8 µV/V 12 µV/V 12 µV/V 14 µV/V	
3 V	10 Hz 20 Hz 40 Hz 50 Hz 100 Hz 400 Hz 1 kHz 3 kHz 10 kHz 20 kHz 30 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	8 µV/V 6 µV/V 6 µV/V 4 µV/V 4 µV/V 4 µV/V 4 µV/V 6 µV/V 6 µV/V 6 µV/V 6 µV/V 6 µV/V 6 µV/V 6 µV/V 10 µV/V 12 µV/V 12 µV/V	

Parameter/Range	Frequency	CMC[2, 12] (±)	Comments
AC/DC Difference, Voltage – Measure, Fixed Points (cont)			
6 V	10 Hz	10 µV/V	Fluke 792A AC/DC transfer standard
	20 Hz	10 µV/V	
	40 Hz	10 µV/V	
	50 Hz	10 µV/V	
	100 Hz	4 µV/V	
	400 Hz	4 µV/V	
	1 kHz	4 µV/V	
	3 kHz	4 µV/V	
	10 kHz	4 µV/V	
	20 kHz	4 µV/V	
	30 kHz	4 µV/V	
	50 kHz	4 µV/V	
	100 kHz	6 µV/V	
	300 kHz	10 µV/V	
	500 kHz	14 µV/V	
	800 kHz	16 µV/V	
	1 MHz	16 µV/V	
10 V	10 Hz	8 µV/V	
	20 Hz	6 µV/V	
	40 Hz	4 µV/V	
	50 Hz	4 µV/V	
	100 Hz	4 µV/V	
	400 Hz	4 µV/V	
	1 kHz	4 µV/V	
	3 kHz	4 µV/V	
	10 kHz	4 µV/V	
	20 kHz	4 µV/V	
	30 kHz	4 µV/V	
	50 kHz	4 µV/V	
	100 kHz	8 µV/V	
	300 kHz	10 µV/V	
	500 kHz	14 µV/V	
	800 kHz	14 µV/V	
	1 MHz	14 µV/V	
20 V	10 Hz	8 µV/V	
	20 Hz	6 µV/V	
	40 Hz	4 µV/V	
	50 Hz	4 µV/V	
	100 Hz	4 µV/V	
	400 Hz	4 µV/V	
	1 kHz	4 µV/V	
	3 kHz	4 µV/V	
	10 kHz	4 µV/V	

Parameter/Range	Frequency	CMC[2, 12] (±)	Comments
AC/DC Difference, Voltage – Measure, Fixed Points (cont)			
20 V	20 kHz 30 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	4 µV/V 4 µV/V 4 µV/V 6 µV/V 6 µV/V 10 µV/V 12 µV/V 12 µV/V	Fluke 792A AC/DC transfer standard
60 V	10 Hz 20 Hz 40 Hz 50 Hz 100 Hz 400 Hz 1 kHz 3 kHz 10 kHz 20 kHz 30 kHz 50 kHz 100 kHz 300 kHz	14 µV/V 10 µV/V 8 µV/V 8 µV/V 8 µV/V 8 µV/V 6 µV/V 6 µV/V 6 µV/V 6 µV/V 6 µV/V 6 µV/V 8 µV/V 28 µV/V	
100 V	10 Hz 20 Hz 40 Hz 50 Hz 100 Hz 400 Hz 1 kHz 3 kHz 10 kHz 20 kHz 30 kHz 50 kHz 100 kHz	14 µV/V 10 µV/V 8 µV/V 8 µV/V 6 µV/V 6 µV/V 6 µV/V 6 µV/V 6 µV/V 6 µV/V 8 µV/V 8 µV/V 8 µV/V	

Parameter/Range	Frequency	CMC[2, 12] (±)	Comments
AC/DC Difference, Voltage – Measure, Fixed Points (cont)			
200 V	10 Hz 20 Hz 40 Hz 50 Hz 100 Hz 400 Hz 1 kHz 3 kHz 10 kHz 20 kHz 30 kHz 50 kHz 100 kHz	18 µV/V 10 µV/V 10 µV/V 10 µV/V 8 µV/V 6 µV/V 6 µV/V 6 µV/V 6 µV/V 6 µV/V 6 µV/V 8 µV/V 12 µV/V	Fluke 792A AC/DC transfer standard
600 V	40 Hz 50 Hz 100 Hz 400 Hz 1 kHz 3 kHz 10 kHz 20 kHz 30 kHz 50 kHz 100 kHz	14 µV/V 14 µV/V 14 µV/V 14 µV/V 8 µV/V 8 µV/V 10 µV/V 12 µV/V 18 µV/V 20 µV/V 28 µV/V	
1000 V	40 Hz 50 Hz 100 Hz 400 Hz 1 kHz 3 kHz 10 kHz 20 kHz	10 µV/V 10 µV/V 10 µV/V 8 µV/V 8 µV/V 8 µV/V 8 µV/V 10 µV/V	

Parameter/Range	Frequency	CMC[2, 4, 12] (±)	Comments
AC/DC Difference, Voltage – Measure, Fixed Points	(All frequencies apply at each voltage)		
(0.5, 1.0, 2.0, 3.0) V	1 MHz 3 MHz 10 MHz 20 MHz 30 MHz 50 MHz 70 MHz 100 MHz	0.010 % 0.024 % 0.07 % 0.09 % 0.12 % 0.25 % 0.60 % 1.2 %	NMI-traceable TVCs, model 1394
Electronic Current – Measure	(10 to 100) fA	0.10 %	Voltage source & resistor current source

IV. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC[2, 12] (±)	Comments
RF Power – Measure			Power ratio with standard thermistor mounts; f = frequency in GHz CF = calibration factor
Coaxial Type N	100 kHz to 1 MHz (>1 to 50) MHz ≥50 MHz to 18 GHz	0.70 % CF 0.60 % CF (0.025f + 0.38) % CF	Agilent 8257 signal generator, Tegam M1111 & M1120 CN mount
Coaxial 3.5 mm	10 MHz to 26.5 GHz	(0.020f + 1.1) % CF	Agilent 8257 signal generator, adapter
Coaxial 2.92 mm	10 MHz to 30 GHz (>30 to 40) GHz	(0.020f + 1.1) % CF (0.12f – 1.9) % CF	Agilent 8474E, adapter
Coaxial 2.4 mm	50 MHz to 30 GHz (>30 to 50) GHz	(0.020 f + 0.80) % CF (0.12f − 2.2) % CF	Agilent 8474E without adapter
Coaxial CN Mount	50 MHz >50 MHz to 18 GHz	0.19 % CF (0.20 + 0.005f + 0.000 48f^2) % CF	Using NIST supplied microcalorimeter

Parameter/Range	Frequency	CMC[2, 12] (±)	Comments
RF Power – Measure (cont) Waveguide Calibration Factors (0.1 to 10) mW			Power ratio with standard thermistor mounts; *f* = frequency in GHz CF = calibration factor
X band (WR-90)	(8.2 to 12.4) GHz	1.8 % CF	Agilent X486A
Ku band (WR-62)	(12.4 to 18) GHz	1.8 % CF	Agilent P486A
K band (WR-42)	(18 to 26.5) GHz	1.8 % CF	Agilent K486A
Ka band (WR-28)	(26.5 to 40) GHz	1.8 % CF	Agilent R486A
Q band (WR-22) (0.1 to 4.0) mW	(33 to 50) GHz	(0.10*f*) % CF	Agilent 8474E with adapter
Thermal Noise – Measure, (5 to 40) dB ENR			Ratio technique with standard noise sources
Coaxial Type N	(0.01 to 18) GHz	0.30 dB	Agilent N4001A
Coaxial 3.5 mm	(0.01 to 26.5) GHz	0.30 dB	Agilent N4002A
Electromagnetic Field Strength – Measure (20 to 62) V/m	0.1 MHz to 40 GHz	2.0 dB	Anechoic chamber & TEM cell with NIST-calibrated tapered dipole antennas
Electromagnetic Power Density – Hazard Probes and Meters (0.1 to 1.0) mW/cm^2	0.1 MHz to 40 GHz	2.0 dB	Anechoic chamber & TEM cell with NIST-calibrated tapered dipole antennas
Attenuation – Measure Incremental Attenuation, (0 to 20) dB	300 kHz to 4 GHz	0.002 dB + 0.002 dB/10 dB	Dual bolometer System (DBS)

Parameter/Range	CMC[2, 12] (±) Magnitude	CMC[2, 12] (±) Phase	Comments
Reflection – Measure S_{11} & S_{22}, Magnitude & Phase			Network analyzer reflectometer, Keysight N5225B
Coaxial Type N			f = frequency in GHz
Rho - Linear			
100 kHz to 18 GHz			
For Magnitude:			Reflection Stds: coaxial mismatches
<0.024	(0.000 30f + 0.0045) dB	180º	
≥0.024 to <0.09	(0.000 30f + 0.0045) dB	20°	
≥0.09 to <0.15	(0.000 30f + 0.0045) dB	(0.10f + 3.0)º	
≥0.15	(0.000 30f + 0.0075) dB	(0.10f + 3.0)º	
Coaxial 3.5 mm			
Rho – Linear			
10 MHz to <50 MHz			
For Magnitude:			
<0.09	(0.000 30f + 0.025) dB	180°	
≥0.09	(0.000 30f + 0.025) dB	(0.17f + 12.5)º	
Coaxial 3.5 mm			
Rho – Linear			
≥50 MHz to 26.5 GHz			
For Magnitude:			
<0.09	(0.000 30f + 0.012) dB	180°	
≥0.09	(0.000 30f + 0.012) dB	(0.17f + 5.0)º	
Coaxial 2.92 mm			
Rho – Linear			Network analyzer reflectometer, Keysight N5225A
50 MHz to 40 GHz			
For Magnitude:			
<0.09	(0.000 30f + 0.013) dB	180°	
≥0.09	(0.000 30f + 0.013) dB	(0.20f + 5.0)º	
Coaxial 2.4 mm			
Rho – Linear			
50 MHz to 50 GHz			
For Magnitude:			
<0.09	(0.000 30f + 0.025) dB	180°	
≥0.09	(0.000 30f + 0.025) dB	(0.50 f + 9.0)º	

Parameter/Range	CMC[2, 12] (±) Magnitude	CMC[2, 12] (±) Phase	Comments
Attenuation – Measure, S_{21} & S_{12}, Magnitude & Phase			Network analyzer with attenuators; f = frequency in GHz A_N = nominal attenuation in dB
Coaxial Type N (0.01 to 18) GHz $A_N \leq 20$ dB $(30 < A_N \leq 50)$ dB $(50 < A_N \leq 60)$ dB	 0.060 dB 0.20 dB 0.30 dB	 $(0.090f + 0.90)^o$ $(0.090f + 0.80)^o$ $(0.090f + 2.0)^o$	 Attenuators within NIST calibrated 9918 verification kit
Coaxial Type N 0.01 to < 0.03 GHz $(20 < A_N \leq 30)$ dB	 0.065 dB	 $(0.090f + 0.60)^o$	
(0.03 to 0.05) GHz $(20 < A_N \leq 30)$ dB	 0.045 dB	 $(0.090f + 0.60)^o$	
> 0.05 to 18 GHz $(20 < A_N \leq 30)$ dB	 0.070 dB	 $(0.090f + 0.60)^o$	
Coaxial 3.5 mm (0.05 to 26.5) GHz $A_N \leq 20$ dB $(20 < A_N \leq 40)$ dB	 $(0.0010f + 0.030)$ dB $(0.0010f + 0.050)$ dB	 $(0.11f + 0.30)^o$ $(0.11f + 0.30)^o$	 NIST calibrated 8493C
Coaxial 2.92 mm (1 to 40) GHz $A_N \leq 20$ dB $(20 < A_N \leq 50)$ dB	 $(0.0016f + 0.030)$ dB $(0.0020f + 0.15)$ dB	 $(0.11f + 0.50)^o$ $(0.11f + 0.50)^o$	 Attenuators within Anritsu model 41KC and verification kit
Coaxial 2.4 mm (1 to 50) GHz $A_N \leq 20$ dB $(20 < A_N \leq 40)$ dB	 $(0.0020f + 0.050)$ dB $(0.0012f + 0.080)$ dB	 $(0.12f + 0.50)^o$ $(0.12f + 0.50)^o$	 Attenuators within Agilent 85057B verification kit

V. Fluid Quantities

Parameter/Equipment	Range	CMC[2, 4, 10] (±)	Comments
M41 PATS Gas Mask Tester Calibration	(1 to 10 000) fit factor	5 %	Aerosol measurement & comparison to CPC
Liquid Properties – Measure Density	(0 to 3) g/cm^3	11 x 10^{-6} g/cm^3	DMA 5000 M vibrating U-tube density meter
Viscosity	<10 mm^2/s (10 to 100) mm^2/s	0.25 % 0.30 %	Cannon Fenske routine or Ubbelohde viscometers
Liquid Flow – Measure	(0.08 to 400) gpm (0.3 to 1600) lpm (0.002 to 2) gpm (0.008 to 8) lpm	0.060 % 0.25 %	Positive displacement liquid flow meter
Gas Flow – Measure	(0.5 to 50) sccm (0.005 to 10) slpm (3 to 15 000) slpm	0.035 % 0.10 % 0.14 %	Constant pressure flow meter (CPFM), gravimetric flow standard (GFS), critical flow venturi (CFV), Molblocs
Air Velocity – Measure	(350 to 880) ft/min (880 to 13 000) ft/min	3.5 ft/min 0.40 %	Wind tunnel – 12”x12” test section using pitot static probe
Aerosol Number Concentration – Measure	(0.5 to 25 000) particles/cm^3, for diameters (20 to 1000) nm	2.5 %	Comparison to aerosol electrometer & linearity test w/diluter
Aerosol Particle Diameter – Measure	(0.01 to 3) µm (1 to 20) µm	2.5 % 2.5 %	Comparison to particle size standards

VI. Ionizing Radiation & Radioactivity

Parameter/Equipment	Range	CMC[2, 4, 5, 8] (±)	Comments
Irradiation of Thermoluminescent Dosimeters and Electronic Dosimeters – (Beta)			
^{90}SrY, ^{85}Kr	Up to 20 µGy/s	6.8 %	NIST traceable sources
Radionuclide Source Calibration[6] –			
^{238}Pu, ^{241}Am	Up to 6 x10^{4} Bq	2.8 %	NIST traceable sources
Radiation Protection Survey Instruments[6] –			
^{238}Pu Exposure (Alpha)	(0 to 2 x 10^{6}) counts/min	7.3 %	NIST traceable alpha sources
^{137}Cs Exposure (Gamma)	0.05 mR/h to 5000 R/h	6.0 %	
(X Ray)			
M30	(20 to 200) R/h	6.0 %	NIST calibrated A3, A4, A5, A6, A8 chambers
M60	(1.5 to 300) R/h	6.0 %	
M100	(1.5 to 300) R/h	6.0 %	
M150	(2.5 to 400) R/h	6.0 %	
H150	(0.3 to 15) R/h	6.0 %	
S75	(50 to 500) R/h	6.0 %	
HK10	(15 to 100) R/h	6.0 %	
HK20	(25 to 250) R/h	6.0 %	
HK30	(20 to 200) R/h	6.0 %	
HK60	(4.0 to 150) R/h	6.0 %	
HK100	(4.0 to 150) R/h	6.0 %	
HK200	(10 to 400) R/h	6.0 %	
HK250	(15 to 500) R/h	6.0 %	
HK280	(15 to 500) R/h	6.0 %	
HK300	(15 to 500) R/h	6.0 %	

Parameter/Equipment	Range	CMC[2, 4, 5, 8] (±)	Comments
Radiation Protection Survey Instruments[6] – (cont)			
(X Ray)			
LK10	(0.15 to 0.80) R/h	6.0 %	NIST calibrated A3, A4, A5, A6, A8 chambers
LK20	(0.4 to 2.5) R/h	6.0 %	
LK30	(0.04 to 0.4) R/h	6.0 %	
LK35	(0.075 to 1.0) R/h	6.0 %	
LK55	(0.015 to 0.5) R/h	6.0 %	
LK70	(0.04 to 0.4) R/h	6.0 %	
LK100	(0.01 to 0.4) R/h	6.0 %	
LK125	(0.0008 to 0.4) R/h	6.0 %	
LK170	(0.0005 to 0.4) R/h	6.0 %	
LK210	(0.005 to 0.25) R/h	6.0 %	
LK240	(0.0015 to 0.3) R/h	6.0 %	
NS10	(1.5 to 10) R/h	6.0 %	
NS15	(1.0 to 8.0) R/h	6.0 %	
NS20	(1.5 to 15) R/h	6.0 %	
NS25	(1.5 to 15) R/h	6.0 %	
NS30	(1.0 to 10) R/h	6.0 %	
NS40	(0.1 to 4.0) R/h	6.0 %	
NS60	(0.2 to 8.0) R/h	6.0 %	
NS80	(0.25 to 5.0) R/h	6.0 %	
NS100	(0.04 to 2.0) R/h	6.0 %	
NS120	(0.2 to 2.0) R/h	6.0 %	
NS150	(0.3 to 10) R/h	6.0 %	
NS200	(0.2 to 5.0) R/h	6.0 %	
NS250	(0.15 to 5.0) R/h	6.0 %	
NS300	(0.25 to 5.0) R/h	6.0 %	
WS60	(0.5 to 20) R/h	6.0 %	
WS80	(1.0 to 40) R/h	6.0 %	
WS110	(0.75 to 25) R/h	6.0 %	
WS150	(1.5 to 50) R/h	6.0 %	
WS200	(2.0 to 100) R/h	6.0 %	
WS250	(2.5 to 100) R/h	6.0 %	
WS300	(3.0 to 150) R/h	6.0 %	
Ion Chambers	0.05 mR/h to 5000 R/h	1.5 %	NIST calibrated A3, A4, A5, A6, A8 chambers

Parameter/Equipment	Range	CMC[2, 4, 5, 8] (±)	Comments
Irradiation of Personnel Dosimeters –			
^{137}Cs (Gamma)	>0.03 R/h	5.7 %	NIST calibrated A3, A4, A5, A6 chambers
(X-Ray) M30, M60, M100, M150, H150, S75, HK10, HK20, HK30 HK60, HK100, HK200 HK280, HK300, LK10 LK20, LK30, LK35 LK55, LK70, LK100 LK125, LK170, LK210 LK240, NS10, NS15 NS20, NS25, NS30 NS40, NS60, NS80 NS100, NS120, NS150 NS200, NS250, NS300 WS60, WS80, WS110 WS150, WS200, WS250, WS300	>0.03 R/h	5.7 %	
Gamma / X-Ray Source Calibration for Air KERMA Rate[6, 7] –			
^{137}Cs[3]	0.05 mR/h to 5000 R/h	2.5 %	Open range NIST traceable A3, A4, A5, A6 chambers
^{137}Cs[3]	0.1 mR/h to 600 R/h	4.6 %	
^{60}Co	0.05 mR/h to 1000 R/h	2.5 %	
NIST Beam Codes M30, M60, M100, M150, H150, S75	(0.3 to 400) R/h	2.5 %	
ISO Beam Codes All HK, LK, NS, WS	0.5 mR/h to 500 R/h	2.5 %	
Liquid Scintillation			
^{3}H (Beta)	(0.17 to 2.4 x 10^{7}) Bq	1.1 %	NIST traceable SRMs
^{63}Ni (Beta)	(0.17 to 2.4 x 10^{7}) Bq	1.0 %	

Parameter/Equipment	Range	CMC[2, 4, 5, 8] (±)	Comments
Nuclear Counting Category Gas Proportional –			
^{241}Am (Alpha)	(0.06 to 3.0 x 10^6) Bq	4.1 %	NIST traceable radionuclides
^{90}SrY (Beta)	(0.11 to 3.0 x 10^6) Bq	3.9 %	
^{137}Cs (Gamma) ^{137}Cs (Beta)	(3.0 x 10^3 to 3.0 x 10^6) Bq (3.0 x 10^3 to 3.0 x 10^6) Bq	4.3 % 3.8 %	
^{60}Co (Gamma) ^{60}Co (Beta)	(5.4 x 10^3 to 3.0 x 10^6) Bq (5.4 x 10^3 to 3.0 x 10^6) Bq	4.4 % 4.4 %	

VII. Mechanical

Parameter/Equipment	Range	CMC[2] (±)	Comments
Mass	1 mg 2 mg 3 mg 5 mg 10 mg 20 mg 30 mg 50 mg 100 mg 200 mg 300 mg 500 mg 1 g 2 g 3 g 5 g 10 g 20 g 30 g 50 g 100 g 200 g 300 g 500 g 1 kg 2 kg 5 kg 10 kg 20 kg	0.0012 mg 0.0012 mg 0.0012 mg 0.0014 mg 0.0015 mg 0.000 17 mg 0.000 17 mg 0.000 17 mg 0.000 17 mg 0.000 17 mg 0.000 17 mg 0.000 21 mg 0.000 22 mg 0.000 25 mg 0.000 26 mg 0.000 33 mg 0.000 70 mg 0.000 91 mg 0.014 mg 0.020 mg 0.029 mg 0.063 mg 0.075 mg 0.10 mg 0.13 mg 1.0 mg 1.1 mg 2.6 mg 9.3 mg	APSL calibration technique # ASL-008 CMC is based upon measurements made using weighing designs & density uncertainties known. Traceability is to NIST by Metric & Avoirdupois standards. Calibration of ounce weights with tolerances of Class 3 or greater can be provided & are traceable through APSL primary standards. Calibration of grain weights with tolerances of Class 3 or greater can be provided & are traceable through APSL metric primary standards.

Parameter/Equipment	Range	CMC[2, 10] (±)	Comments
Mass (cont)	0.001 lb (0.4535924 g) 0.002 lb (0.9071847 g) 0.003 lb (1.360777 g) 0.005 lb (2.267962 g) 0.01 lb (4.53592 g) 0.02 lb (9.07185 g) 0.03 lb (13.6078 g) 0.05 lb (22.6796 g) 0.1 lb (45.3592 g) 0.2 lb (90.7185 g) 0.3 lb (136.078 g) 0.5 lb (226.796 g) 1 lb (453.592 g) 2 lb (907.185 g) 3 lb (1360.78 g) 5 lb (2267.96 g) 10 lb (4535.92 g) 20 lb (9071.85 g) 25 lb (11.3398 kg) 50 lb (22.6796 kg) 100 lb (45.3592 kg)	0.0036 mg 0.0058 mg 0.014 mg 0.018 mg 0.027 mg 0.027 mg 0.027 mg 0.033 mg 0.040 mg 0.040 mg 0.076 mg 0.084 mg 0.14 mg 0.16 mg 0.67 mg 2.0 mg 4.9 mg 8.0 mg 11 mg 23 mg 43 mg	APSL calibration technique # ASL-008 CMC is based upon measurements made using weighing designs & density uncertainties known. Traceability is to NIST by Metric & Avoirdupois standards. Calibration of ounce weights with tolerances of Class 3 or greater can be provided & are traceable through APSL primary standards. Calibration of grain weights with tolerances of Class 3 or greater can be provided & are traceable through APSL metric primary standards.
Force – Load Cells, Proving Rings, etc.	(10 to 1000) lbf (1000 to 112 000) lbf (112 000 to 1 000 000) lbf	0.015 % of full scale 0.015 % of full scale 0.05 % of full scale	Dead weight force machine Morehouse hydraulic force machine

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
Vacuum – Measure	(0 to 120) torr	$27 \times 10^{-6}\ p + 5.9$ mPa	Force balanced piston gauge; p = pressure (torr)
Volume – Measure	500 mL to 5 L	58 µL/L	Gravimetric method
Accelerometer	(2 to 50) Hz (0.1 to 1) g (2 to 4 Hz) 5 Hz to 1 kHz (>1 to 5) kHz (>5 to 15) kHz (5 to 50) Hz (>50 to 160) Hz >160 Hz to 1 kHz (>1 to 5) kHz (>5 to 15) kHz	1.0 % 2.3 % 1.0 % 1.5 % 2.0 % 0.5 % 0.3 % 0.5 % 1.0 % 1.5 %	Long stroke shaker with optical encoder Comparison calibration The Modal Shop 9155C shaker system with laser option
Pressure – Mercury Manometer	Up to 100 in Hg	0.82 Pa + 0.0017 %	Schwien mercury manometer
Pressure – Piston Gages	(1.5 to 25) psi (25 to 100) psi (25 to 1000) psi (1000 to 10 000) psi (10 000 to 20 000) psi (0 to 2) psi (2 to 50) psi (0 to 15) kPa	$(1.4 \times 10^{-5})\ p$ $(1.6 \times 10^{-5})\ p$ $(2.2 \times 10^{-5})\ p$ $(3.5 \times 10^{-5})\ p$ $(3.7 \times 10^{-5})\ p$ $(3.0 \times 10^{-5})\ p$ $(1.8 \times 10^{-5})\ p$ $(1.2 \times 10^{-5})\ p$	Deadweight piston gage Air Data calibration system PG-7607; p = pressure (psi)
Pressure – Gas Effective Area of Piston - Cylinder	 (4 to 400) kPa (400 to 800) kPa (800 to 4000) kPa (4000 to 10 000) kPa (10 to 20) MPa (20 to 50) MPa (50 to 100) MPa (100 to 200) MPa	 0.0014 % 0.0015 % 0.0018 % 0.0018 % 0.0017 % 0.0016 % 0.0022 % 0.0037 %	Comparison with standard piston – cylinders using the piston gage cross float systems.

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Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
Pressure – Oil Effective Area of Piston - Cylinder	 (2 to 10) MPa (10 to 100) MPa (100 to 200) MPa	 0.0017 % 0.0020 % 0.0022 %	Comparison with standard piston – cylinders using the piston gage cross float systems.

VIII. Optical Quantities

Parameter/Equipment	Range	CMC[2, 4, 10] (±)	Comments
Fiber Optics Power – Measure 10 nW to 100 µW	 850 nm 1310 nm 1550 nm	 1.5 % 1.5 % 1.5 %	Detector based
Fiber Optic Source Wavelength – Measure	(600 to 1700) nm	0.50 nm	Spectrum analyzer & intrinsic source
Spectral Radiance – (300 to 1600) nm	$(1x10^{-9}$ to $1x10^{-5})$ $Wcm^{-2}sr^{-1}nm^{-1}$	4.0 %	Detector & source based
Detector Spectral Response – Measure	Power: Si (350 to 1030) nm (1030 to 1065) nm (1065 to 1100) nm Ge (700 to 1650) nm (1650 to 1720) nm (1720 to 1800) nm (V or A)/(W nm^{-1}) Irradiance: Si (350 to 1030) nm (1035 to 1065) nm (1070 to 1100) nm Ge (700 to 1650) nm (1655 to 1720) nm (1725 to 1800) nm (V or A)/(W cm^{-2} nm^{-1})	 3.4 % 4.0 % 4.5 % 3.2 % 3.8 % 5.3 % 4.1 % 4.6 % 5.1 % 4.0 % 3.8 % 5.3 %	Detector based Si, Ge

Parameter/Equipment	Range	CMC[2, 4, 10] (±)	Comments
Photometric – Measure			
Illuminance	(2 to 500) fcd	2.0 %	Detector & source based
Luminance	(10 to 10 000) fL	2.0 %	
Color Temperature	(2000 to 3200) K	17 K	
Laser Energy – Measure, (1064 nm)	200 nJ to 20 mJ	5.0 %	Detector based & using beamsplitters
Laser Power – Measure			
488 nm	100 mW to 3 W	5.0 %	Detector based & using beamsplitters
514.5 nm	100 mW to 3 W	5.0 %	
632.8 nm	1 µW to 30 mW	5.0 %	
780 nm	1 µW to 30 mW	5.0 %	
1064 nm	100 mW to 8 W	5.0 %	
UV Irradiance – Measure, (365 nm)	(600 to 2000) W/cm^2	8.0 %	Detector based

IX. Thermodynamics

Parameter/Equipment	Range	CMC[2, 10] (±)	Comments
Humidity – Measure	(10 to 90) % RH	0.5 % RH	Two-pressure chamber
Standard Platinum Resistance Thermometers – Fixed Point Calibrations			
Triple Point of Water	0.01 °C	0.0010 °C	Triple points & freezing points using AC bridge
Triple Point of Ar	-189.3442 °C	0.0025 °C	
Triple Point of Hg	-38.8344 °C	0.0017 °C	
Melting Point of Ga	29.7646 °C	0.0018 °C	
Freeze Point of Sn	231.928 °C	0.0026 °C	
Freeze Point of Zn	419.527 °C	0.0038 °C	

Parameter/Equipment	Range	CMC[2, 10] (±)	Comments
Non-Fixed Point Calibration of Temperature Devices Using SPRT	(-80 to 420) °C	0.008 °C	Direct comparison in baths
Non-Fixed Point Calibration of Temperature Devices Using Thermocouples	(0 to 1000) °C	0.75 °C	Direct comparison using Type S thermocouple
Infrared Temperature Calibration – Measure			
Using TRT IV.82 Thermometer	(-5 to 1000) °C (1000 to 1100) °C	1.2 °C 2.5 °C	Any IR measurement over the stated range using TRT IV.82
Using Near Infra-Red Thermometer (NIRT)	(156 to 850) °C (851 to 1020) °C (1021 to 1100) °C	0.73 °C 0.80 °C 0.98 °C	Any IR measurement over the stated range using NIRT

X. Time & Frequency

Parameter/Equipment	Range	CMC[2, 10] (±)	Comments
Frequency – Measuring Equipment	10 MHz	1.2 pHz/Hz	Microsemi 4310B
	1 Hz to < 1 kHz	10 nHz/Hz	Keysight 33250A w/ Microsemi 4310B
	1 kHz to 50 GHz	1 nHz/Hz	Keysight 33250A/E8257D w/ Microsemi 4310B
Frequency - Measure	1 Hz to < 1 kHz	10 nHz/Hz	Keysight 53131A w/ Microsemi 4310B
	1 kHz to 50 GHz	1 nHz/Hz	Keysight 53131A/N9030B w/ Microsemi 4310B

[1] This laboratory offers limited commercial calibration services and field calibration services.

[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. CMC's 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. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the Calibration and Measurement Capability Uncertainty (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 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, percentages are percentage of reading, unless otherwise indicated. *D* is the diameter of the unit under test in the units indicated, unless otherwise indicated. *L* is the length of unit under test in the units indicated.

[5] CMCs are valid for the nominal intensity range listed.

[6] For calibration outside of the nominal intensity range shown, uncertainties would be determined commensurate with the Parameter/Equipment of the reference field calibration.

[7] Enclosed calibration range.

[8] CMCs are the estimated "best uncertainties" of the laboratory reference fields established to perform the indicated operations.

[9] Effects of tests for non-repeatability, nonlinearity, hysteresis, and environmental factors can cause uncertainties to be larger than the CMC for balances and scales.

[10] 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.

[11] This scope meets A2LA's *P112 Flexible Scope Policy*.

[12] 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. CMC's 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.

Accredited Laboratory

A2LA has accredited

U.S. ARMY PRIMARY STANDARDS LABORATORY

Redstone Arsenal, AL

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 ANSI/NCSLI Z540-1-1994 and 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 14th day of March 2023.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 1256.01
Valid to December 31, 2024

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