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

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CALIBRATION

Valid To: March 31, 2028 Certificate Number: 2147.01

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the organization's compliance with R205 – A2LA's Calibration Program Requirements), accreditation is granted to this laboratory to perform the following calibrations[1, 11]:

I. Acoustical Quantities

Parameter/Equipment	Range	CMC[2, 8] (±)	Comments
Sound Level – Measuring Equipment, Fixed Points[3]	94 dB 114 dB	0.28 dB 0.28 dB	Bruel & Kjaer 4231

II. Chemical

Parameter/Equipment	Range	CMC[2] (±)	Comments
pH Meters, Fixed Points[3]	4 pH 7 pH 10 pH	0.011 pH 0.012 pH 0.018 pH	Standard pH solutions
Conductivity Meters[3]	10 µS/cm 1413 µS/cm 10 000 µS/cm 100 000 µS/cm	4.4 µS/cm 9.8 µS/cm 51 µS/cm 470 µS/cm	Standard conductivity solutions

III. Dimensional

Parameter/Equipment	Range	CMC[2, 6] (±)	Comments
Calipers[3] – Dial, Digital, Vernier –			
Length	Up to 18 in (18 to 48) in	(290 + 7.3*L*) µin (240 + 4.9*L*) µin	Gage blocks
Parallelism	Up to 2 in	30 µin	
Depth Gauge[3] – Dial, Digital, Vernier	(0.001 to 48) in	(59 + 7.2*L*) µin	Gage blocks, surface plate
Gage Blocks –	Up to 10 in	(5.0 + 0.95*L*) µin	Pratt & Whitney Labmaster™ LMU-175, gauge blocks, optical flat
	Up to 4 in 4 to 24 in	(5.4 + 0.75*L*) µin (5.0 + 0.95*L*) µin	Mahr comparator, gauge blocks
Parallelism (Variation in Length)	(0.01 to 4) in	0.9 µin	
Height Gauges[3]	Up to 18 in (18 to 36) in	(30 + 6.5*L*) µin (16 + 7.3*L*) µin	Gage blocks
Indicators – Dial & Digital[3]	(0.000 01 to 2) in	(11 + 8.9*L*) µin	Gage blocks, surface plate, Pratt &Whitney Supermic™
Length Standards[3] (Length only)	Up to 10 in (10 to 20) in (20 to 96) in	(3.2 + 1.0*L*) µin (7.8 + 15*L*) µin (45 + 17*L*) µin	Pratt & Whitney Labmaster™ LMU-175, micrometer head, gage blocks, P&W PC25
Measuring Rule[3]	Up to 48 in	(300 + 4.0*L*) µin	Hexagon Optiv Classic 321
Measuring Tapes[3,6]	Up to 300 in	0.015 + (0.004*S*) in	Master ruler, surface plate

Parameter/Equipment	Range	CMC[2, 6] (±)	Comments
Micrometers[3] –			
Outside Diameter	Up to 48 in	(30 + 13*L*) µin	Gage blocks
Inside Diameter	Up to 24 in	(30 + 13*L*) µin	
Flatness	Up to 2 in	4.3 µin	Optical flat
Parallelism	Up to 2 in	4.3 µin	
Optical Comparators[3] –			
Angularity	(0 to 180)°	0.79 arc min	Sine bar, gage blocks
Linearity X-Y	Up to 12 in	160 µin	Glass scale
Magnification	Up to 50X	0.0035 in	Magnification master
Plain Gage[3] –			
Pins, Plugs, & Discs	Up to 1 in (1 to 10) in (10 to 20) in	(7.8 + 9.1*L*) µin (2.9 + 14*L*) µin (11 + 13*L*) µin	Pratt & Whitney Labmaster™ LMU-175, gage blocks, P&W PC25
Rings	Up to 1 in (1 to 10) in	(6.3 + 12*L*) µin (2.4 + 16*L*) µin	
Protractors[3]	Up to 90°	0.060°	Surface plate, sine bar, gage blocks
Sine Bars –			
Length	(5 to 10) in	(76 + 4.6*L*) µin	Hexagon Optiv Classic 321, Hexagon Global S Chrome
Parallelism	(5 to 10) in	29 µin	Electronic gauge head
Surface Plates[3] –			
Flatness	Up to 170 in diagonal	(7.1 $\sqrt{D}$) µin	Mahr Federal EMD-832-W3 electronic level
Repeatability	(-0.002 to 0.002) in	28 µin	Rahn Repeat-O-Meter
Thickness Gauge[3] (Feeler Type)	(0.001 to 1) in	(8.6 + 30*L*) µin	Pratt & Whitney Labmaster™ LMU-175

Parameter/Equipment	Range	CMC[2, 9] (±)	Comments
Thickness Gauge[3] (Ultrasonic)	(0.001 to 8) in	590 µin	Gage blocks
Thread Gauges –			
Thread Ring, Adjustable[3]	Up to 4 in	Thread Plug tolerance (W)	Set using master plug gages. ASME/ANSI B1.2-1983 & ASME/ANSI B1.3-2007
Thread Plugs			
Major Diameter	Up to 3 in	79 µin	Pratt & Whitney Labmaster™ LMU-175, gauge blocks, thread wires
Pitch Diameter	Up to 3 in| (6 to 80) TPI	120 µin	
Thread Wires	(6 to 80) TPI	12 µin	Labmaster™ LMU-175, gauge blocks

IV. Dimensional Testing/Calibration[10]

Parameter/Equipment	Range	CMC[2, 6] (±)	Comments
Dimensional Inspection –			
Linear (1D)	Up to 10) mm (10 to 100) mm (100 to 300) mm	0.0017 mm 0.0021 mm 0.0030 mm	Hexagon Optiv Classic 321
Volumetric	(300 x 200 x 150) mm	0.0042 mm	Hexagon Global S Chrome
3D Fixtures & Artifacts	(24 x 32 x 22) in	(65 + 2.8*L*) µin	

V. Electrical DC/Low Frequency

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
DC Voltage[3] – Generate			
Fixed point	10 V	0.5 µV/V	Fluke 732B
DC Voltage[3] – Measure	0 V Short	0.62 µV/V	Copper short
	(0 to 100) mV	2.7 µV/V + 0.84 µV	HP 3458A Opt. 002 digital multimeter
	(0.1 to 1) V	2.0 µV/V + 5.7 µV	
	(1 to 10) V	4.4 µV/V + 88 µV	
	(10 to 100) V	1.5 µV/V + 2.0 mV	
	(100 to 1000) V	5.3 µV/V + 2.0 mV	
	(1 to 10) kV	0.35 mV/V + 35 mV	Vitrek 4700 high voltage multimeter, Vitrek HVL-150 high voltage probe
	(10 to 100) kV	0.58 mV/V + 0.50 V	
	(100 to 125) kV	0.17 kV	
	(125 to 140) kV	0.29 kV	
DC Voltage[3] – Generate	(0 to 220) mV	9.6 µV/V + 0.63 µV	Fluke 5700A
	(0.22 to 2.2) V	4.3 µV/V + 4.4 µV	
	(2.2 to 11) V	4.0 µV/V + 4.5 µV	
	(11 to 22) V	4.1 µV/V + 4.9 µV	
	(22 to 220) V	5.7 µV/V + 98 µV	
	(220 to 1100) V	7.8 µV/V + 660 µV	
	(0.1 to 1.0) kV	0.61 V	HV Source monitored by Vitric 4700
	(1.0 to 4.0) kV	2.5 V	
	(4.0 to 9.0) kV	4.7 V	
	(9.0 to 25) kV	38 V	HV Source monitored by Vitrek 4700/HVL-150 probe
	(25 to 50) kV	58 V	
	(50 to 60) kV	81 V	

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
DC Current[3] –			
Measure	(0 to 100) µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A (1 to 10) A	36 µA/A + 0.5 nA 31 µA/A + 5 nA 32 µA/A + 50 nA 52 µA/A + 0.5 µA 0.15 mA/A + 5uA 0.26 mA/A	HP 3458A opt. 002 digital multimeter Y5020
	(10 to 1000) A (1 to 2.8) kA	4.2 mA/A + 0.5A 12 mA/A + 0.5A	LEM PR2000 current clamp, HP 3458A opt. 002 digital multimeter
	10 µA 100 µA 1 mA 10 mA 20 mA 200 mA 2 A 20 A	12 µA/A 12 µA/A 24 µA/A 24 µA/A 24 µA 24 µA 26 µA 32 µA	HP 3458A opt. 002, Fluke A40B series current shunts
Generate	(0 to 220) µA (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A	10 nA/A + 7.1 nA 8.7 nA/A + 13 nA 8.7 nA/A + 49 nA 1.1 nA/A + 0.84 µA 2.0 nA/A + 31 µA	Fluke 5700A
	(1.1 to 3) A (3 to 11) A (11 to 20.5) A	400 µA/A + 1.5 mA 1 mA/A + 2.4 mA 1.1 mA/A + 2.4 mA	Fluke 5520A
Clamp Meters	(20.5 to 1000) A	6.0 mA/A + 0.60 A	Fluke 5520A w/ coil

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
Resistance[3] – Generate			
Fixed	0.000 333 3 Ω	1.2 mΩ/Ω	9211A Guildline
	0.001 Ω	0.58 mΩ/Ω	
	0.01 Ω	0.12 mΩ/Ω	
	0.1 Ω	0.12 mΩ/Ω	
	1 Ω	0.12 mΩ/Ω	
	10 Ω	0.12 mΩ/Ω	
	100Ω	0.12 mΩ/Ω	
	1k Ω	0.12 mΩ/Ω	
	10 kΩ	0.12 mΩ/Ω	
	10 MΩ	0.32 kΩ	Metrohm P4085 series resistors
	1 GΩ	0.56 MΩ	
	10 GΩ	0.61 MΩ	
	100 GΩ	0.12 GΩ	
	1 TΩ	2.6 GΩ	
	0 Ω	47 µΩ	Fluke 5720A
	1 Ω	110 µΩ	
	1.9 Ω	110 µΩ	
	10 Ω	35 µΩ	
	19 Ω	43 µΩ	
	100 Ω	0.15 mΩ	
	190 Ω	0.28 mΩ	
	1 kΩ	1.6 mΩ	
	1.9 kΩ	2.9 mΩ	
	10 kΩ	15 mΩ	
	19 kΩ	29 mΩ	
	100 kΩ	0.18 Ω	
	190 kΩ	0.30 Ω	
	1 MΩ	17 Ω	
	1.9 MΩ	19 Ω	
	10 MΩ	71 Ω	
	19 MΩ	250 Ω	
	100 MΩ	4.2 kΩ	

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
Resistance[3] – Measure	(0 to 10) Ω (10 to 100) Ω (100 to 1000) Ω (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 100) MΩ 100 MΩ to 1 GΩ Up 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	29 μΩ/Ω + 0.58 mΩ 12 μΩ/Ω + 0.58 mΩ 12 μΩ/Ω + 5.8 mΩ 12 μΩ/Ω + 58 mΩ 18 μΩ/Ω + 2.3 Ω 58 μΩ/Ω + 0.12 kΩ 5.8 mΩ/Ω + 12 kΩ 5.8 mΩ/Ω + 12 kΩ 28 μΩ/Ω 25 μΩ/Ω 17 μΩ/Ω 14 μΩ/Ω 14 μΩ/Ω 14 μΩ/Ω 19 μΩ/Ω 28 μΩ/Ω 0.014 % 0.12 % 0.23 %	HP 3458A Opt. 002, digital multimeter Fluke 8508A
Resistance[3] – Generate	(0 to 1) Ω (1 to 1.9) Ω (1.9 to 10) Ω (10 to 19) Ω (19 to 100) Ω (100 to 190) Ω (190 to 1000) Ω (1000 to 1900) Ω (1.9 to 10) kΩ (10 to 19) kΩ (19 to 100) kΩ (100 to 190) kΩ (0.19 to 1) MΩ (1 to 1.9) MΩ (1.9 to 100) MΩ	46 μΩ/Ω + 1.2 mΩ 46 μΩ/Ω + 1.2 mΩ 46 μΩ/Ω + 1.2 mΩ 34 μΩ/Ω + 1.8 mΩ 28 μΩ/Ω + 3.5 mΩ 28 μΩ/Ω + 3.5 mΩ 29 μΩ/Ω + 6.3 mΩ 27 μΩ/Ω + 4.0 mΩ 26 μΩ/Ω + 100 mΩ 27 μΩ/Ω + 40 mΩ 26 μΩ/Ω + 1 Ω 33 μΩ/Ω + 3.4 Ω 30 μΩ/Ω + 11 Ω 63 μΩ/Ω + 0.05 kΩ 0.52 mΩ/Ω + 10 kΩ	Fluke 5520A
Resistance[3] – Current Shunt	Up to 80 mΩ (80 to 800) mΩ (0.8 to 1000) Ω	320 μΩ/Ω + 1.3 nΩ 140 μΩ/Ω + 4.7 nΩ 81 μΩ/Ω + 16 μΩ	Fluke 5520A, HP 3458A Opt.002 digital multimeter

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
AC Voltage[3] – Measure			
(0 to 2.2) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.43 mV/V + 1.5 µV 0.25 mV/V + 1.5 µV 0.25 mV/V + 1.5 µV 0.46 mV/V + 2.3 µV 0.69 mV/V + 2.9 µV 1.4 mV/V + 4.6 µV 1.5 mV/V + 9.2 µV 2.7 mV/V + 9.2 µV	Fluke 5790A
(2.2 to 7) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.22 mV/V + 1.5 µV 0.13 mV/V + 1.5 µV 0.13 mV/V + 1.5 µV 0.24 mV/V + 2.3 µV 0.36 mV/V + 2.9 µV 0.95 mV/V + 4.6 µV 1.0 µV/V + 9.2 µV 2.0 mV/V + 9.2 µV	
(7 to 22) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.15 mV/V + 1.8 µV 78 µV/V + 1.8 µV 78 µV/V + 1.8 µV 0.14 mV/V + 3.1 µV 0.24 mV/V + 5.9 µV 0.63 mV/V + 4.7 µV 0.82 mV/V + 9.3 µV 1.3 mV/V + 9.3 µV	
(22 to 70) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	99 µV/V + 1.9 µV 45 µ/V + 1.9 µV 45 µV/V + 1.9 µV 70 µV/V + 4.1 µV 0.14 mV/V + 9.8 µV 0.31 mV/V + 5.0 µV 0.45 mV/V + 9.5 µV 1.2 mV/V + 9.6 µV	
(70 to 220) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	15 µV/V + 77 µV 3.6 µV/V + 65 µV 3.6 µV/V + 65 µV 6.6 µV/V + 85 µV 7.8 µV/V + 0.15 mV 24 µV/V + 0.28 mV 59 µV/V + 0.28 mV 0.44 mV/V + 0.28 mV	

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
AC Voltage[3] – Measure (cont)			
(220 to 700) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	12 µV/V + 0.17 mV 3.4 µV/V + 83 µV 3.4 µV/V + 84 µV 24 µV/V + 36 µV 39 µV/V + 49 µV 44 µV/V + 0.34 mV 92 µV/V + 0.35 mV 0.68 µV/V + 0.36 mV	Fluke 5790A
(0.7 to 2.2) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	28 µV/V + 0.22 mV 15 µV/V + 45 µV 15 µV/V + 45 µV 52 µV/V + 16 µV 83 µV/V + 26 µV 0.22 mV/V + 50 µV 0.13 mV/V + 1.7 mV 0.89 mV/V + 1.5 mV	
(2.2 to 7) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	70 µ/V + 80 µV 25 µ/V + 59 µV 25 µV/V + 59 µV 49 µV/V + 59 µV 87 µV/V + 52 µV 0.23 mV/V + 40 µV 0.45 mV/V + 0.19 mV 1.3 mV/V + 0.43 mV	
(7 to 22) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	76 µV/V + 0.12 mV 34 µV/V + 0.10 mV 34 µV/V + 0.10 mV 62 µV/V + 0.10 mV 100 µV/V + 0.30 mV 0.20 mV/V + 0.86 mV 0.45 mV/V + 0.75 mV 1.4 mV/V + 0.58 mV	
(22 to 70) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz	75 µV/V + 0.51 mV 30 µV/V + 0.64 mV 30 µV/V + 0.64 mV 74 µV/V + 0.51 mV 100 µV/V + 1.1 mV 0.21 vmV/V + 2.8 mV 0.57 mV/V + 1.0 mV	

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
AC Voltage[3] – Measure (cont)			
(70 to 220) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz	80 µV/V + 0.51 mV 35 µV/V + 0.64 mV 35 µV/V + 0.64 mV 78 µV/V + 0.51 mV 0.11 mV/V + 1.1 mV 0.23 mV/V + 2.8 mV 0.58 mV/V + 1.0 mV	Fluke 5790A
(220 to 700) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.11 mV/V + 4.2 mV 43 µV/V + 3.4 mV 43 µV/V + 3.4 mV 90 µV/V + 64 mV 0.31 mV/V + 0.27 V	
(700 to 1000) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.11 mV/V + 4.2 mV 44 µV/V + 3.4 mV 44 µV/V + 3.4 mV 0.11 mV/V + 64 mV 0.37 mV/V + 0.27 V	
AC Voltage – Wideband Measure			
(0 to 2.2) mV	(10 to 30) Hz (30 to 120) Hz (0.12 to 1.2) kHz (1.2 to 120) kHz (120 to 500) kHz	7.9 mV/V + 1.9 µV 7.5 mV/V + 1.9 µV 7.5 mV/V + 1.9 µV 7.5 mV/V + 1.9 µV 7.7 mV/V + 3.0 µV	Fluke 5790A w/ wideband opt.
(2.2 to 7) mV	(10 to 30) Hz (30 to 120) Hz (0.12 to 1.2) kHz (1.2 to 120) kHz (120 to 500) kHz	7.7 mV/V + 2.6 µV 7.2 mV/V + 2.6 µV 7.2 mV/V + 2.6 µV 7.2 mV/V + 2.6 µV 7.4 mV/V + 3.7 µV	
(7 to 22) mV	(10 to 30) Hz (30 to 120) Hz (0.12 to 1.2) kHz (1.2 to 120) kHz (120 to 500) kHz	7.4 mV/V + 4.9 µV 6.9 mV/V + 4.9 µV 6.9 mV/V + 4.9 µV 6.9 mV/V + 4.9 µV 7.0 mV/V + 6.6 µV	
(22 to 70) mV	(10 to 30) Hz (30 to 120) Hz (0.12 to 1.2) kHz (1.2 to 120) kHz (120 to 500) kHz	7.4 mV/V + 6.1 µV 6.8 mV/V + 6.1 µV 6.8 mV/V + 6.1 µV 6.8 mV/V + 6.1 µV 6.7 mV/V + 6.1 µV	

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
AC Voltage – Wideband Measure (cont.)			
(70 to 220) mV	(10 to 30) Hz (30 to 120) Hz (0.12 to 1.2) kHz (1.2 to 120) kHz (120 to 500) kHz	7.0 mV/V + 35 µV 6.4 mV/V + 35 µV 6.4 mV/V + 35 µV 6.4 mV/V + 35 µV 6.4 mV/V + 35 µV	Fluke 5790A w/ wideband opt.
(220 to 700) mV	(10 to 30) Hz (30 to 120) Hz (0.12 to 1.2) kHz (1.2 to 120) kHz (120 to 500) kHz	5.8 mV/V + 93 µV 5.1 mV/V + 93 µV 5.1 mV/V + 93 µV 5.1 mV/V + 93 µV 5.1 mV/V + 93 µV	
(0.7 to 2.2) V	(10 to 30) Hz (30 to 120) Hz (0.12 to 1.2) kHz (1.2 to 120) kHz (120 to 500) kHz	5.7 mV/V + 0.35 mV 5.0 mV/V + 0.35 mV 5.0 mV/V + 0.35 mV 5.0 mV/V + 0.35 mV 5.0 mV/V + 0.35 mV	
(2.2 to 7) V	(10 to 30) Hz (30 to 120) Hz (0.12 to 1.2) kHz (1.2 to 120) kHz (120 to 500) kHz	5.2 mV/V + 0.49 mV 4.4 mV/V + 0.49 mV 4.4 mV/V + 0.49 mV 4.4 mV/V + 0.49 mV 4.4 mV/V + 0.49 mV	
AC Voltage[3] – Generate			
(0.005 to 2.2) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.022 % + 5.2 µV 0.011 % + 5.2 µV 0.011 % + 5.2 µV 0.038 % + 5.2 µV 0.087 % + 8.1 µV 0.12 % + 15 µV 0.17 % + 29 µV 0.36 % + 29 µV	Fluke 5700A
(2.2 to 220) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.022 % + 9.5 µv 0.011 % + 9.6 µv 0.011 % + 9.4 µV 0.018 % + 62 µV 0.058 % + 130 µV 0.11 % + 37 µV 0.18 % + 41 µV 0.37 % + 93 µV	

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
AC Voltage[3] – Generate (cont)			
(0.22 to 2.2) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.016 % + 48 µV 0.074 % + 14 µV 0.075 % + 11 µV 29 µV/V + 0.70 mV 0.016 % + 0.38 mV 0.046 % + 0.15 mV 0.11 % + 0.42 mV 0.22 % + 1.0 mV	Fluke 5700A
(2.2 to 22) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.016 % + 0.38 mV 73 µV/V + 0.15 mV 75 µV/V + 0.12 mV 0.011 % + 0.82 mV 0.024 % + 0.47 mV 0.053 % + 1.7 mV 0.14 % + 5.0 mV 0.29 % + 1.0 mV	
(22 to 220) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.17 % + 3.9 mV 80 µV/V + 1.6 mV 82 µV/V + 1.2 mV 0.023 % + 4.2 mV 0.53 % + 9.5 mV 0.17 % + 0.11 V 0.53 % + 0.11 V 1.3 % + 0.22 V	
(220 to 750) V	(15 to 50) Hz (0.05 to 1) kHz	0.043 % + 19 mV 77 µV/V + 9.3 mV	
(220 to 750) V	(0.03 to 10) kHz (10 to 33) kHz (33 to 100) kHz	29 µV/V 0.13 mV/V 0.58 mV/V	Wavetek 4808 Monitored with Fluke 5790A
(750 to 1050) V	(0.04 to 10) kHz (10 to 33) kHz	29 µV/V 0.13 mV/V	
(1 to 33) mV	(10 to 45) Hz (0.045 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	99 µV/V + 19 µV 99 µV/V + 19 µV 9.3 µV/V + 250 µV 48 µV/V + 140 µV 0.045 % + 100 µV 0.22 % + 87 µV	Fluke 5520A

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
AC Voltage[3] – Generate (cont)			
(33 to 330) mV	(10 to 45) Hz (0.045 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.012 % + 0.12 mV 0.012 % + 0.12 mV 13 µV/V + 1.8 mV 35 µV/V + 1.1 mV 0.045 % + 0.43 mV 0.26 % + 0.80 mV	Fluke 5520A
(0.33 to 3.3) V	(10 to 45) Hz (0.045 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.017 % + 0.71 mV 0.017 % + 0.71 mV 0.027 % + 0.72 mV 0.040 % + 0.74 mV 0.10 % + 1.9 mV 0.28 % + 0.80 mV	
(3.3 to 33) V	(10 to 45) Hz (0.045 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.021 % + 3.0 mV 0.022 % + 7.8 mV 0.024 % + 10 mV 0.019 % + 20 mV 0.22 % + 62 mV	
(33 to 330) V	(0.045 to 1) kHz (1 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.033 % + 19 mV 0.030 % + 32 mV 0.028 % + 11 mV 0.31 % + 20 mV 0.23 % + 63 mV	
(330 to 1020) V	(0.045 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.034 % + 19 mV 0.028 % + 20 mV 0.033 % + 32 mV	
(0.1 to 1.0) kV (1.0 to 4.0) kV (4.0 to 9.0) kV	(50 to 60) Hz (50 to 60) Hz (50 to 60) Hz	2.1 V 6.4 V 18 V	HV source monitored by Vitrek 4700
(9.0 to 10) kV	(50 to 60) Hz	0.12 kV	HV source monitored by Vitrek 4700 w/ HVL-150 probe
AC Voltage[3] – Measure			
10 mV	(10 to 40) Hz (40 to 1000) Hz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	340 µV/V + 3.7 µV 230 µV/V + 1.4 µV 340 µV/V + 1.4 µV 1.2 mV/V + 1.6 µV 5.8 mV/V + 1.5 µV 47 mV/V + 2.7 µV	HP 3458A

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
AC Voltage[3] – Measure (cont.)			
100 mV	(10 to 40) Hz (40 to 1000) Hz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz (1 to 2) MHz	56 µV/V + 110 µV 73 µV/V + 38 µV 160 µV/V + 35 µV 110 µV/V + 690 µV 0.68 mV/V + 0.33 mV 3.3 mV/V + 0.27 mV 12 mV/V + 97 µV 17 mV/V + 420 µV	HP 3458A
1 V	(10 to 40) Hz (40 to 1000) Hz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz (1 to 2) MHz	56 µV/V + 1.1 mV 65 µV/V + 0.46 mV 0.16 mV/V + 0.35 mV 0.32 mV/V + 0.69 mV 0.92 mV/V + 0.38 mV 3.5 mV/V + 1.6 mV 12 mV/V + 0.97 mV 17 mV/V + 4.3 mV	
10 V	(10 to 40) Hz (40 to 1000) Hz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 1) MHz (1 to 2) MHz	0.21 mV/V + 7.3 mV 0.23 mV/V + 3.4 mV 0.23 mV/V + 3.3 mV 0.41 mV/V + 3.0 mV 1.4 mV/V + 3.4 mV 4.6 mV/V + 13 mV 17 mV/V + 22 mV 17 mV/V + 22 mV	
100 V	(10 to 40) Hz (40 to 1000) Hz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz	0.44 mV/V + 54 mV 0.45 mV/ + 30 mV 0.64 mV/V + 34 mV 1.3 mV/V + 40 mV 3.6 mV/V + 20 mV 4.1 mV/V + 0.7 V 18 mV/V + 0.8 V	
700 V	(10 to 40) Hz (40 to 1000) Hz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.45 mV/V + 37 mV 0.45 mV/V + 37 mV 1.4 mV/V + 42 mV 3.5 mV/V + 42 mV 3.5 mV/V + 42 mV	
(1 to 10) kV	(0.01 to 600) Hz	1.4 mV/V + 0.12 V	Vitrek 4700 high voltage multimeter
(10 to 75) kV (60.0 to 80) kV (80.0 to 100.0) kV	(0.01 to 600) Hz (50 to 60) Hz (50 to 60) Hz	1.1 mV/V + 0.77 V 0.49 kV 0.59 kV	Vitrek 4700 with HVL-150 high voltage probe

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
AC Current[3] – Measure			
Up to 100 µA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 1) kHz	1.9 mA/A + 0.56 µA 0.37 mA/A + 0.58 µA 91 µA/A + 0.58 µA 84 µA/A + 0.57 µA	HP 3458 opt. 002 digital multimeter
(1 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	4.7 mA/A + 24 µA 1.8 mA/A + 24 µA 0.70 mA/A + 24 µA 0.35 mA/A + 24 µA 0.70 mA/A + 24 µA 4.7 mA/A + 47 µA 6.4 mA/A + 170 µA	
(0.1 to 1) A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz (5 to 20) kHz (20 to 50) kHz	4.7 mA/A + 0.24 mA 1.9 mA/A + 0.24 mA 0.92 mA/A + 0.25 mA 1.1 mA/A + 0.25 mA 3.5 mA/A + 0.24 mA 12 mA/A + 0.47 mA	
(1 to 20) A	(2 to 10) kHz 3 Hz to 10 kHz	0.10 % 0.30 %	Fluke 8508A
(20 to 2800) A	1 Hz to 10 kHz	12 mA/A	LEM PR2000 current clamp, HP 3458A opt. 002 digital multimeter
10 µA	(0.01 to 1) kHz (1 to 10) kHz (10 to 30) kHz (30 to 100) kHz	1.2 µA/A 1.1 µA/A 1.1 µA/A 1.9 µA/A	Fluke A40B series shunts, Fluke 5790
100 µA	(0.01 to 1) kHz (1 to 10) kHz (10 to 30) kHz (30 to 100) kHz	6.8 µA/A 9.0 µA/A 9.1 µA/A 18 µA/A	
1 mA	(0.01 to 1) kHz (1 to 10) kHz (10 to 30) kHz (30 to 100) kHz	68 µA/A 90 µA/A 91 µA/A 0.18 mA/A	
10 mA	(0.01 to 1) kHz (1 to 10) kHz (10 to 30) kHz (30 to 100) kHz	37 µA/A 37 µA/A 39 µA/A 59 µA/A	

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
AC Current[3] – Measure (cont)			
20 mA	(0.01 to 1) kHz (1 to 10) kHz (10 to 30) kHz (30 to 100) kHz	37 µA/A 37 µA/A 39 µA/A 59 µA/A	Fluke A40B series shunts, Fluke 5790
200 mA	(0.01 to 1) kHz (1 to 10) kHz (10 to 30) kHz (30 to 100) kHz	37 µA/A 37 µA/A 39 µA/A 59 µA/A	
2 A	(0.01 to 1) kHz (1 to 10) kHz (10 to 30) kHz (30 to 100) kHz	38 µA/A 41 µA/A 43 µA/A 75 µA/A	
20 A	(0.01 to 1) kHz (1 to 10) kHz (10 to 30) kHz (30 to 100) kHz	48 µA/A 63 µA/A 96 µA/A 0.21 mA/A	
AC Current[3] – Generate			
(0.02 to 220) µA	(10 to 20) Hz (20 to 40) Hz (0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.93 mA/A + 30 nA 0.49 mA/A + 25 nA 0.20 mA/A + 20 nA 0.83 mA/A + 50 nA 0.21 % + 0.1 µA	Fluke 5700A
(0.22 to 2.2) mA	(10 to 20) Hz (20 to 40) Hz (0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.93 mA/A + 50 nA 0.49 mA/A + 40 nA 0.19 mA/A + 40 nA 0.82 mA/A + 0.5 µA 0.21 % + 1.0 µA	
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz (0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.94 mA/A + 0.5 µA 0.49 mA/A + 0.4 µA 0.19 mA/A + 0.4 µA 0.82 mA/A + 5.0 µA 0.21 % + 10 µA	
(22 to 220) mA	(10 to 20) Hz (20 to 40) Hz (0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.93 mA/A + 5.0 µA 0.49 mA/A + 4.0 µA 0.22 mA/A + 4.0 nA 0.82 mA/A + 50 µA 0.21 % + 0.10 mA	

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
AC Current[3] – Generate (cont)			
(0.22 to 2.2) A	(0.02 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.87 mA/A + 40 µA 0.99 mA/A + 0.10 mA 1.2 % + 0.20 mA	Fluke 5700A
(1.1 to 3) A	(10 to 45) Hz (0.045 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.21 % + 0.10 mA 0.76 mA/A + 0.10 mA 0.70 % + 1.0 mA 2.9 % + 5.0 mA	Fluke 5520A
(3 to 11) A	(45 to 100) Hz (0.1 to 1) kHz (1 to 5) kHz	0.74 mA/A + 2.0 mA 0.12 % + 2.0 mA 3.5 % + 2.0 mA	
(11 to 20.5) A	(45 to 100) Hz (0.1 to 1) kHz (1 to 5) kHz	0.15 % + 5.0 mA 0.18 % + 5.0 mA 3.5 % + 5.0 mA	
(20.5 to 150) A			
Toroidal	(45 to 65) Hz (65 to 440) Hz	0.41 mA/A 0.96 mA/A	Fluke 5520A, 5500A/coil
Non-Toroidal	(45 to 65) Hz (65 to 440) Hz	8.7 mA/A 14 mA/A	
(150 to 1000) A			
Toroidal	(45 to 65) Hz (65 to 440) Hz	0.41 mA/A 0.96 mA/A	
Non-Toroidal	(45 to 65) Hz (65 to 440) Hz	7.9 mA/A 13 mA/A	

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
DC Power – Generate[3]	(0.010 89 to 10.89) mW (10.890 to 99) mW (99 to 336.6) W (336.6 to 3060) W (3060 to 20 910) W	0.033 % 0.14 % 0.14 % 0.12 % 0.07 %	Fluke 5520A
AC Power – Generate[3] (45 to 65) Hz/PF=1	 (0.1089 to 0.297) mW (0.297 to 2.97) mW (2.97 to 10.89) mW (10.89 to 72.60) mW (72.60 to 1485) mW (1.485 to 6.765) W (6.765 to 33.66) W (33.66 to 336.6) W (336.6 to 917.9) W (917.9 to 2244) W (2244 to 20 910) W	 0.17 % 0.13 % 0.12 % 0.24 % 0.23 % 0.21 % 0.19 % 0.22 % 0.21 % 0.23 % 0.13 %	Fluke 5520A
Phase Angle[3] – Measure (0 to 359.9999) ° Generate (0 to 999.999) °	 10 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 200) kHz 1 Hz to 1 kHz (1 to 50) kHz (50 to 200) kHz	 0.012° 0.017° 0.051° 0.11° 0.028° 0.056° 0.068°	 North Atlantic PAV 2250A Clarke Hess 5000
Inductance[3] – Measure Generate Fixed points	 (0.1 to 10) µH (0.01 to 10) mH 0.01 to 100) mH (0.1 to 10) kH (10 to 100) kH 20 mH 100 mH 200 mH 2 H	 0.022 µH 0.21 µH 0.02 H 6.4 H 0.61 kH 0.012 mH 0.054 mH 0.12 mH 1.3 mH	 HP 4284A General radio 1482 series inductors

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
Inductance[3] – (cont)			
Variable	(1 to 10) mH (10 to 100) mH (0.1 to 1) H (1 to 10) H	9.5 µH 0.81 mH 0.011 H 0.2 H	General radio 1490D
Capacitance[3] – Fixed	1 nF 2 nF 10 nF 100 nF 200 nF 1 µF	0.50 pF 1.1 pF 5.4 pF 7.4 pF 0.10 nF 0.19 nF	General radio 1409 series standard capacitors
Capacitance[3] –			
Measure	(0 to 1) nF (0.001 to 10) µF (0.001 to 10) mF (0.01 to 110) mF	1.1 pF 5.4 nF 0.011 mF 0.28 mF	HP 4284A
Generate	(0.19 to 0.4) nF (0.4 to 1.1) nF (1.1 to 3.3) nF (3.3 to 11) nF (11 to 33) nF (33 to 110) nF (110 to 330) nF (0.33 to 1.1) µF (1.1 to 3.3) µF (3.3 to 11) µF (11 to 33) µF (33 to 110) µF (110 to 330) µF (0.33 to 1.1) mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 100) mF	0.26 % + 13 pF 0.56 % + 12 pF 0.27 % + 13 pF 0.29 % + 120 pF 0.27 % + 140 pF 0.27 % + 390 pF 0.27 % + 1.3 nF 0.27 % + 3.9 nF 0.25 % + 15 nF 0.26 % + 42 nF 0.38 % + 170 nF 0.45 % + 480 nF 0.50 % + 1.4 µF 0.44 % + 4.9 µF 0.26 % + 36 µF 0.78 % + 49 µF 0.83 % + 360 µF 1.1 % + 360 µF	Fluke 5520A

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
Thermocouple Indicating_Simulation[3], [1_2]			
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.58 °C 0.20 °C 0.18 °C 0.20 °C 0.26 °C	Fluke 5520A
Type J	(-210 to -30) °C (-30 to 50) °C (50 to 500) °C (500 to 1200) °C	0.30 °C 0.29 °C 0.16 °C 0.23 °C	
Type K	(-200 to -100) °C (-100 to -30) °C (-30 to 120) °C (120 to 1050) °C (1050 to 1371.1) °C	0.35 °C 0.19 °C 0.17 °C 0.15 °C 0.23 °C	
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.42 °C 0.24 °C 0.21 °C 0.20 °C 0.28 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.62 °C 0.41 °C 0.37 °C 0.43 °C	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.53 °C 0.41 °C 0.41 °C 0.49 °C	
Type T	(-250 to -150) °C (-150 to -100) °C (-100 to 0) °C (0 to 400) °C	0.64 °C 0.26 °C 0.18 °C 0.15 °C	

Parameter/Equipment	Range	CMC[2] (±)	Comments
RTD Simulation[3], [1–2]			
Cu427	100 to 260 °C	0.34 °C	Fluke 5520A
Ni120	(-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.085 °C 0.084 °C 0.15 °C	
Pt 385, 100 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.090 °C 0.093 °C 0.11 °C 0.13 °C 0.14 °C 0.15 °C 0.25 °C	
Pt 385, 200 Ω	(-200 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.046 °C 0.055 °C 0.13 °C 0.14 °C 0.15 °C 0.17 °C	
Pt 385, 500 Ω	(-200 to -80) °C (-80 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.042 °C 0.051 °C 0.061 °C 0.081 °C 0.092 °C 0.12 °C	
Pt 385, 1000 Ω	(-200 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 600) °C (600 to 630) °C	0.031 °C 0.041 °C 0.052 °C 0.062 °C 0.072 °C 0.23 °C	
Pt 3916, 100 Ω	(-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.28 °C 0.058 °C 0.067 °C 0.075 °C 0.093 °C 0.11 °C 0.11 °C 0.12 °C 0.24 °C	
Pt 3926, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.066 °C 0.083 °C 0.11 °C 0.12 °C 0.14 °C	

Parameter/Equipment	Range	CMC[2] (±)	Comments
Oscilloscopes –			
Amplitude – DC Signal[3]			
50 Ω Load	(0 to 6) V	29 mV/V + 0.58 mV	5520A-SC1100 multifunction calibrator w/ oscilloscope opt
1 MΩ Load	(0 to 130) V	590 µV/V + 75 µV	
Amplitude – Square Wave			
50 Ω Load	1 mV_{p-p} to 6.6 V_{p-p}; 10 Hz to 10 kHz	29 mV_{p-p}/V_{p-p} + 75 μV_{p-p}	
1 MΩ Load	1 mV_{p-p} to 130 $V_{p-p;}$ 10 Hz to 10 kHz	280 $\mu V_{p-p}/V_{p-p}$ + 75 μV_{p-p}	
Oscilloscopes – Rise Time			5520A-SC1100 multifunction calibrator w/ oscilloscope opt
(0.001 to 2) MHz	(200 to 300) ps	120 ps	
(2 to 10) MHz	(250 to 350) ps	140 ps	
Oscilloscopes – Bandwidth[3]			
5 mV to 5.5 V_{p-p}	50 kHz 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	58 mV_{p-p}/V_{p-p} + 470 μV_{p-p} 58 mV_{p-p}/V_{p-p} + 470 μV_{p-p} 70 mV_{p-p}/V_{p-p} + 470 μV_{p-p} 120 mV_{p-p}/V_{p-p} + 470 μV_{p-p}	5520A-SC1100 multifunction calibrator w/ oscilloscope opt
4 mV to 3.5 V_{p-p}	(600 to 1100) MHz	140 mV_{p-p}/V_{p-p} + 470 μV_{p-p}	
Leveled Sine Wave – Frequency[3]	50 kHz to 1.1 GHz	0.58 kHz	
Time Marker	2 ns to 20 ms 50 ms to 5 s	2.9 µs/s + 0.15 ps 1.2 ms/s + 58 µs	
Dissipation Factor – Measure (Df)[3]			Multi-frequency LCR Meter cts: Counts of LSD
1 pF to 100 µF	(0.0001 to 10) Df	3.5 % + 1 cts	

Parameter/Equipment	Range	CMC[2] (±)	Comments
Oscilloscopes –			
Wave Functions - Square, Sine, & Triangle[3]			
50 Ω Load	1.8 mV_{p-p} to 2.5 V_{p-p}; 10 Hz to 10 kHz	35 mV_{p-p}/V_{p-p} + 120 μV_{p-p}	5520A-SC1100 multifunction calibrator w/ oscilloscope opt
1 MΩ Load	1.8 mV_{p-p} to 55 V_{p-p}; 10 Hz to 10 kHz	35 mV_{p-p}/V_{p-p} + 120 μV_{p-p}	
Pulse Characteristics[3] –			
Pulse Width	(4 to 500) ns	2.6 ns	
Pulse Period	200 ns to 20 ms	150 ps	
Rise Time – Generate	1 kHz to 2 MHz (200 to 300) ps	120 ps	
	2 to 10 MHz (200 to 350) ps	120 ps	

VI. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
RF Power[3] – Measure			
(-35 to +20) dB	DC to 100 MHz 100 MHz to 4 GHz (4 to 8) GHz (8 to 12.4) GHz (12.4 to 18) GHz (18 to 26.5) GHz (26.5 to 30) GHz (30 to 35) GHz (35 to 40) GHz	0.061 dB 0.077 dB 0.091 dB 0.11 dB 0.13 dB 0.11 dB 0.13 dB 0.14 dB 0.14 dB	Rohde & Schwarz NRP-Z55
(-30 to +20) dB	50 MHz to 50 GHz	0.11 dB	HP 8487A, Agilent E4418B

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
RF Power – Generate			
(-100 to +24) dB (-100 to +20) dB (-100 to +18) dB	1 mHz to 4.024 GHz (1.4 to 20) GHz (20 to 26.5) GHz	0.60 dB 1.2 dB 1.2 dB	Fluke 96270A leveled microwave output
Leveled Sine Wave – Generate			
(-130 to -94) dBm	(10 to 128) MHz 128 MHz to 3 GHz	0.74 dB 1.6 dB	Fluke 96270A
(-94 to -84) dBm	100 kHz to 10 MHz (10 to 128) MHz (128 to 300) MHz 300 MHz to 3 GHz	0.52 dB 0.35 dB 0.51 dB 1.1 dB	
(-84 to -74) dBm	100 kHz to 10 MHz (10 to 128) MHz (128 to 300) MHz 300 MHz to 1.4 GHz (1.4 to 4) GHz	0.51 dB 0.13 dB 0.33 dB 0.54 dB 1.1 dB	
(-74 to -48) dBm	100 kHz to 10 MHz (10 to 128) MHz (128 to 300) MHz 300 MHz to 1.4 GHz (1.4 to 4) GHz	0.21 dB 0.11 dB 0.11 dB 0.43 dB 0.58 dB	
(-48 to -17) dBm	(10 to 100) kHz 100 kHz to 128 MHz (128 to 300) MHz 300 MHz to 1.4 GHz (1.4 to 3) GHz (3 to 4) GHz	0.032 dB 0.062 dB 0.079 dB 0.22 dB 0.38 dB 0.53 dB	
(-17 to +14) dBm	(10 to 100) kHz 100 kHz to 128 MHz (128 to 300) MHz 300 MHz to 1.4 GHz (1.2 to 4) GHz	0.031 dB 0.059 dB 0.079 dB 0.22 dB 0.33 dB	
(+14 to +20) dBm	(10 to 100) kHz 100 kHz to 128 MHz (128 to 300) MHz 300 MHz to 1.4 GHz	0.051 dB 0.058 dB 0.11 dB 0.26 dB	
(+20 to +24) dBm	(10 to 100) kHz 100 kHz to 128 MHz	0.031 dB 0.059 dB	

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
Attenuation[3, 5] – Measure			
10 Hz to 128 MHz	(0 to 55) dB (55 to 64) dB (64 to 100) dB (100 to 116) dB	0.044 dB 0.057 dB 0.17 dB 0.23 dB	Fluke 96270A, Rohde & Schwarz FSP
Amplitude Modulation[3] – Measure			
Carrier: 150 kHz to 10 MHz			
Rate: 50 Hz to 10 kHz	Depth: (5 to 99) %	2.7 %	HP 8901B
Rate: 20 Hz to 10 kHz	Depth: (5 to 99) %	3.8 %	
Carrier: 10 MHz to 1.3 GHz			
Rate: 50 Hz to 50 kHz	Depth: (5 to 99) %	1.9 %	
Rate: 20 Hz to 100 kHz	Depth: (5 to 99) %	3.8 %	
Amplitude Modulation[3] – Generate			
Carrier: 50 kHz to 4 GHz			
Rate: 1 Hz to 100 kHz	Depth: (5 to 10) % Depth: (10 to 99) %	1.6 % 3.9 %	Fluke 96270A
Frequency Modulation[3] –Measure			
Carrier: 150 kHz to 10 MHz			
Rate: 20 Hz to 10 kHz	Deviation: Up to 40 kHz	26 mHz/Hz + 310 mHz	HP 8901B
Carrier: 10 MHz to 1.3 GHz			
Rate: 50 Hz to 100 kHz	Deviation: Up to 400 kHz	15 mHz/Hz + 320 mHz	
Carrier: 10 MHz to 1.3 GHz			
Rate: 20 Hz to 200 kHz	Deviation: Up to 400 kHz	59 mHz/Hz + 290 mHz	
Frequency Modulation[3] –Generate			
Carrier: 9 MHz to 31.25 MHz			
Rate: 1 Hz to 50 kHz	Deviation:	11 mHz/Hz	Fluke 96270A
Rate: 50 Hz to 300 kHz	10 Hz to 300 kHz	60 mHz/Hz	
Carrier: 31.25 MHz to 125 MHz			
Rate: 1 Hz to 50 kHz	Deviation:	11 mHz/Hz	
Rate: 50 Hz to 300 kHz	10 Hz to 750 kHz	36 mHz/Hz	
Carrier: 125 MHz to 4 GHz			
Rate: 1 Hz to 50 kHz	Deviation:	11 mHz/Hz	
Rate: 50 Hz to 300 kHz	10 Hz to 4.8 MHz	36 mHz/Hz	

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
Phase Modulation[3] – Measure Carrier: 150 kHz to 10 MHz Rate: 200 Hz to 10 kHz Carrier: 10 MHz to 1.3 GHz Rate: 200 Hz to 20 kHz	 Deviation: Up to 420 rad Deviation: Up to 420 rad	 0.050 rad/rad + 0.067 rad 0.040 rad/rad + 0.067 rad	 HP 8901B
Amplitude Modulation[3] – Sine Distortion – Measure (10.0 to 89.0) %	 50 kHz to 125 MHz	 -40 dBc	 HP 8903B
Phase Modulation[3] – Generate Carrier: 9 MHz to 4 GHz Rate: 1 Hz to 50 kHz Rate: 50 kHz to 300 kHz	 Deviation: Up to 1000 rad	 0.011 rad/rad 0.036 rad/rad	 Fluke 96270A
Total Harmonic Distortion[3] – Measure	47 Hz to 100 kHz	1.7 %	North Atlantic PAV 2250A

VII. Mechanical

Parameter/Equipment	Range	CMC[2, 6] (±)	Comments
Accelerometers[3] Voltage Sensitivity – Up to 1000 mV/g's	 50 Hz to 2 kHz (2 to 10) kHz (5 to 9) Hz (10 to 99) Hz 100 Hz (101 to 1999) Hz (2 to 10) kHz	 3.5 % 5.0 % 2.7 % 2.6 % 2.3 % 2.3 % 5.6 %	 Modal Shop 9100D Portable Modal shop 9150D shaker, digital multimeter, Function generator, PCB signal conditioner

Parameter/Equipment	Range	CMC[2, 6, 8] (±)	Comments
Scales & Balances[3] –			
Linearity Only	(1 to 50) mg (50 to 500) mg (0.5 to 1) g (1 to 5) g (5 to 50) g (50 to 100) g (100 to 200) g (200 to 2000) g (2000 to 6000) g	0.017 mg 0.027 mg 0.055 mg 0.055 mg 0.16 mg 0.64 mg 0.77 mg 6.9 mg 0.14 g	Class 1 weights
	(1.0 to 2.0) lbf (2.0 to 5.0) lbf (5.0 to 10.0) lbf (10.0 to 20.0) lbf (20.0 to 100.0) lbf (100.0 to 200.0) lbf	1.1×10^{-3} lbf 2.0×10^{-3} lbf 3.5×10^{-3} lbf 2.6×10^{-3} lbf 9.2×10^{-3} lbf 1.6×10^{-2} lbf	Reference weights
Force – Measuring Equipment[3]	(1 to 100) lb	0.052 %	Transducer techniques MDB-10, Rice Lake RL20000I-100, Rice Lake RL2000I-T10-500
	(50 to 500) lb (0.5 to 5) klb	0.090 % 0.16 %	Interface RL9000TWM-5K
	(10 to 100) klb	0.049 %	Omega LCW-100K
Pneumatic Pressure – Measuring Equipment[3]	(-15 to 0) psig	0.0015 psi	Fluke PM500
	Up to 5 psig (5 to 15) psig	0.001 psi 0.003 psi	Fluke PPC4EX
	Up to 15 psig (15 to 30) psig Up to 45 psig (45 to 90) psig Up to 150 psig (150 to 300) psig Up to 500 psig (500 to 1000) psig Up to 1500 psig (1500 to 3000) psig	0.0015 psi 0.003 psi 0.0046 psi 0.0091 psi 0.015 psi 0.030 psi 0.051 psi 0.10 psi 0.15 psi 0.31 psi	Fluke PM500
	3000 to 6000 psig (6000 to 10 000) psig	8.6 psi 9.5 psi	Fluke 700P31

Parameter/Equipment	Range	CMC[2, 6, 8] (±)	Comments
Tachometers[3] – Optical	(30 to 250 000) rpm	12 µRPM/RPM + 0.6*R*	Fluke 5520A with LED
Torque – Measure[3]	(1 to 9) lbf·in (5 to 50) lbf·in (50 to 300) lbf·in (10 to 150) lbf·ft (150 to 600) lbf·ft (600 to 1000) lbf·ft	2.1 % 0.64 % 0.38 % 0.35 % 0.31 % 7.1 lbf·ft	Delta Regis DRBT-10 Sturtevant Richmont system 8 w/ transducers Torque transducers w/ torque analyzer
Mass Flow (Gas) – Measure	(0 to 0.5) slpm (0.5 to 5) slpm (5 to 50) slpm (50 to 100) slpm	0.03 % + 0.0011 slpm 0.26 % + 0.03 slpm 0.26 % + 0.0002 slpm 0.13 % + 0.0002 slpm	Fluke Molbox1+ A700K, Molbloc-L 3E4-VCR-V-Q, Molbloc-L 5E3-VCR-V-Q

VIII. Thermodynamics

Parameter/Equipment	Range	CMC[2, 8] (±)	Comments
Humidity[3] – Measuring Equipment	(5 to 95) % RH	0.84 % RH	Rotronic HF53W-ID, Rotronic HC2A probe
Temperature[3] – Measuring Equipment			
Thermometers	(-20 to 375) °C (375 to 600) °C	0.088 °C 0.32 °C	WIKA CTP5000-450 probe
Infrared	(-15 to 0) °C (0 to 50) °C (50 to 100) °C (100 to 120) °C (35 to 100) °C (100 to 200) °C (200 to 350) °C (350 to 500) °C (500 to 1000) °C (1000 to 1100) °C (1100 to 1400) °C (1400 to 1500) °C	0.96 °C 0.99 °C 1.0 °C 1.2 °C 0.82 °C 1.4 °C 2.0 °C 3.0 °C 7 °C 9 °C 10 °C 11 °C	Fluke 4180 wavelength (8 to 14) µm emissivity 0.95 Fluke 4181 wavelength (8 to 14) µm emissivity 0.95 Mikron 335 wavelength (0.65 to 1.8) µm emissivity 1.0

Parameter/Equipment	Range	CMC[2, 8] (±)	Comments
Infrared – Measure[3]	(30 to 100) °C (100 to 150) °C (150 to 200) °C (200 to 250) °C (160 to 500) °C (500 to 900) °C (900 to 1300) °C (1300 to 1650) °C	2.4 °C 3.5 °C 4.7 °C 6 °C 3 °C 4 °C 5 °C 5 °C	Infrared camera Fluke VT04 wavelength (6.5 to 14) µm emissivity 0.01 to 1.0 Infrared camera Williamson SW-22- 45C-FOV wavelength (2.2) µm emissivity 0.01 to 1.5
Temperature – Measure[3] (Ovens, chambers, cells, furnaces, autoclaves)	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 420) °C (420 to 550) °C (550 to 660) °C (660 to 700) °C (700 to 800) °C (800 to 900) °C (900 to 1000) °C	0.084 °C 0.034 °C 0.037 °C 0.085 °C 0.12 °C 0.13 °C 3.8 °C 4.0 °C 4.0 °C 4.0 °C	Fluke 5615-12 probe, Fluke 1524 reference thermometer Fluke 9144 w/ Fluke 5609 SPRT Pyromation S-type probe

IX. Time & Frequency

Parameter/Equipment	Range	CMC[2, 8] (±)	Comments
Frequency[3] – Measuring Equipment Reference Oscillator	0.001 Hz to 10 kHz 10 kHz to 4 GHz (4 to 26) GHz 10 MHz	0.091 µHz/Hz 0.060 µHz/Hz 0.058 µHz/Hz 0.12 mHz	Fluke 96270A Trimble Thunderbolt E
Frequency[3] – Measure	 1 mHz to 3 GHz (3 to 20) GHz	 30 nHz/Hz 46 nHz/Hz	 Agilent 53132A Agilent 53147A
Timers/Stopwatches[3]	Up to 24 hr	0.065 s/day	Timometer 4500

SATELLITE

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CALIBRATION

In recognition of the successful completion of the A2LA evaluation process (including an assessment of the organization's compliance with R205 – A2LA's Calibration Program Requirements), accreditation is granted to this laboratory to perform the following calibrations[1, 11]:

I. Acoustical Quantities

Parameter/Equipment	Range	CMC[2, 8] (±)	Comments
Sound Level – Measuring Equipment, Fixed Points[3]	94 dB 114 dB	0.28 dB 0.28 dB	Bruel & Kjaer 4231

II. Chemical

Parameter/Equipment	Range	CMC[2] (±)	Comments
pH Meters, Fixed Points[3]	4 pH 7 pH 10 pH	0.011 pH 0.012 pH 0.018 pH	Standard pH solutions
Conductivity Meters[3]	10 µS/cm 1413 µS/cm 10 000 µS/cm 100 000 µS/cm	4.4 µS/cm 9.8 µS/cm 51 µS/cm 470 µS/cm	Standard conductivity solutions

III. Dimensional

Parameter/Equipment	Range	CMC[2, 6] (±)	Comments
Calipers[3] – Dial, Digital, Vernier –			
Length	Up to 18 in (18 to 48) in	(290 + 7.3*L*) µin (240 + 4.9*L*) µin	Gage blocks
Parallelism	Up to 2 in	30 µin	
Depth Gauge[3] – Dial, Digital, Vernier	(0.001 to 48) in	(59 + 7.2*L*) µin	Gage blocks, surface plate
Height Gauges[3]	Up to 18 in (18 to 36) in	(30 + 6.5*L*) µin (16 + 7.3*L*) µin	Gage blocks
Indicators – Dial & Digital[3]	(0.000 01 to 2) in	(11 + 8.9*L*) µin	Gage blocks, surface plate, Pratt & Whitney
Length Standards[3] (Length only)	Up to 10 in	(3.2 + 1.0*L*) µin	P&W PC25
Measuring Tapes[3,6]	Up to 300 in	0.015 + (0.004*S*) in	Master ruler, surface plate
Micrometers[3] –			
Outside Diameter Inside Diameter	Up to 48 in Up to 24 in	(30 + 13*L*) µin (30 + 13*L*) µin	Gage blocks
Flatness Parallelism	Up to 2 in Up to 2 in	4.3 µin 4.3 µin	Optical flat
Protractors[3]	Up to 90°	0.060°	Surface plate, sine bar, gage blocks

Parameter/Equipment	Range	CMC[2, 6] (±)	Comments
Optical Comparators[3] –			
Angularity	(0 to 180)°	0.79 arc min	Sine bar, gage blocks
Linearity X-Y	Up to 12 in	160 µin	Glass scale
Magnification	Up to 50X	0.0035 in	Magnification master, pin gauge
Plain Gage[3] –			
Pins & Plugs	Up to 1 in (1 to 10) in	(7.8 + 9.1*L*) µin (2.9 + 14*L*) µin	P&W PC25 up to Y
Surface Plates[3] –			
Flatness	Up to 170 in diagonal	(7.1 √*D*) µin	Mahr Federal EMD-832-W3 electronic level
Repeatability	(-0.002 to 0.002) in	28 µin	Rahn Repeat-O-Meter
Thickness Gauge[3] (Feeler Type)	(0.001 to 1) in	(8.6 + 30*L*) µin	Pratt & Whitney
Thickness Gauge[3] (Ultrasonic)	(0.001 to 8) in	590 µin	Gage blocks
Thread Gauges –			
Thread Ring, Adjustable[3]	Up to 4 in	Thread Plug tolerance (W)	Set using master plug gages. ASME/ANSI B1.2-1983 & ASME/ANSI B1.3- 2007
Thread Plugs			
Major Diameter	Up to 3 in	79 µin	Pratt & Whitney, gauge blocks, thread wires
Pitch Diameter	Up to 3 in| (6 to 80) TPI	120 µin	

IV. Electrical DC/Low Frequency

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
DC Voltage[3]— Measure	0 V Short	0.62 µV/V	Copper short
	(0 to 100) mV	2.7 µV/V + 0.84 µV	HP 3458A Opt. 002 digital multimeter
	(0.1 to 1) V	2.0 µV/V + 5.7 µV	
	(1 to 10) V	4.4 µV/V + 88 µV	
	(10 to 100) V	1.5 µV/V + 2.0 mV	
	(100 to 1000) V	5.3 µV/V + 2.0 mV	
	(1 to 10) kV	0.35 mV/V + 35 mV	Vitrek 4700 high voltage multimeter, Vitrek HVL-150 high voltage probe
	(10 to 100) kV	0.58 mV/V + 0.50 V	
	(100 to 125) kV	0.17 kV	
	(125 to 140) kV	0.29 kV	
DC Voltage[3] – Generate	(0 to 220) mV	9.6 µV/V + 0.63 µV	Fluke 5700A
	(0.22 to 2.2) V	4.3 µV/V + 4.4 µV	
	(2.2 to 11) V	4.0 µV/V + 4.5 µV	
	(11 to 22) V	4.1 µV/V + 4.9 µV	
	(22 to 220) V	5.7 µV/V + 98 µV	
	(220 to 1100) V	7.8 µV/V + 660 µV	
	(0.1 to 1.0) kV	0.61 V	HV Source monitored by Vitric 4700
	(1.0 to 4.0) kV	2.5 V	
	(4.0 to 9.0) kV	4.7 V	
	(9.0 to 25) kV	38 V	HV Source monitored. by Vitrek 4700/HVL-150 probe
	(25 to 50) kV	58 V	
	(50 to 60) kV	81 V	
DC Current[3] –			
Measure	(0 to 100) µA	36 µA/A + 0.5 nA	HP 3458A opt. 002 digital multimeter
	(0.1 to 1) mA	31 µA/A + 5 nA	
	(1 to 10) mA	32 µA/A + 50 nA	
	(10 to 100) mA	52 µA/A + 0.5 µA	
	(0.1 to 1) A	0.15 mA/A + 5uA	
	(1 to 10) A	0.26 mA/A	Y5020
	(10 to 1000) A	4.2 mA/A + 0.5A	LEM PR2000 current clamp, HP 3458A opt. 002 digital multimeter
	(1 to 2.8) kA	12 mA/A + 0.5A	
Generate	(0 to 220) µA	10 nA/A + 7.1 nA	Fluke 5700A
	(0.22 to 2.2) mA	8.7 nA/A + 13 nA	
	(2.2 to 22) mA	8.7 nA/A + 49 nA	
	(22 to 220) mA	1.1 nA/A + 0.84 µA	
	(0.22 to 2.2) A	2.0 nA/A + 31 µA	

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
DC Current[3] – (cont)			
Generate	(1.3 to 3) A (3 to 11) A (11 to 20.5) A	400 µA/A + 1.5 mA 1 mA/A + 2.4 mA 1.1 mA/A + 2.4 mA	Fluke 5700A
Clamp Meters	(20.5 to 1000) A	6.0 mA/A + 0.60 A	Fluke 5520A w/ coil
Resistance[3] – Generate			
Fixed	0.000 333 3 Ω 0.001 Ω 0.01 Ω 0.1 Ω 1 Ω 10 Ω 100Ω 1k Ω 10 kΩ	1.2 mΩ/Ω 0.58 mΩ/Ω 0.12 mΩ/Ω 0.12 mΩ/Ω 0.12 mΩ/Ω 0.12 mΩ/Ω 0.12 mΩ/Ω 0.12 mΩ/Ω 0.12 mΩ/Ω	9211A Guildline
	10 MΩ 1 GΩ 10 GΩ 100 GΩ 1 TΩ	0.32 kΩ 0.56 MΩ 0.61 MΩ 0.12 GΩ 2.6 GΩ	Metrohm P4085 series resistors
	0 Ω 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	47 µΩ 110 µΩ 110 µΩ 35 µΩ 43 µΩ 0.15 mΩ 0.28 mΩ 1.6 mΩ 2.9 mΩ 15 mΩ 29 mΩ 0.18 Ω 0.30 Ω 17 Ω 19 Ω 71 Ω 250 Ω 4.2 kΩ	Fluke 5700A

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
Resistance[3] – Measure	(0 to 10) Ω (10 to 100) Ω (100 to 1000) Ω (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 100) MΩ 100 MΩ to 1 GΩ Up 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	29 µΩ/Ω + 0.58 mΩ 12 µΩ/Ω + 0.58 mΩ 12 µΩ/Ω + 5.8 mΩ 12 µΩ/Ω + 58 mΩ 18 µΩ/Ω + 2.3 Ω 58 µΩ/Ω + 0.12 kΩ 5.8 mΩ/Ω + 12 kΩ 5.8 mΩ/Ω + 12 kΩ 28 µΩ/Ω 25 µΩ/Ω 17 µΩ/Ω 14 µΩ/Ω 14 µΩ/Ω 14 µΩ/Ω 19 µΩ/Ω 28 µΩ/Ω 0.014 % 0.12 % 0.23 %	HP 3458A Opt. 002, digital multimeter Fluke 8508A
Resistance[3] – Generate	(0 to 1) Ω (1 to 1.9) Ω (1.9 to 10) Ω (10 to 19) Ω (19 to 100) Ω (100 to 190) Ω (190 to 1000) Ω (1000 to 1900) Ω (1.9 to 10) kΩ (10 to 19) kΩ (19 to 100) kΩ (100 to 190) kΩ (0.19 to 1) MΩ (1 to 1.9) MΩ (1.9 to 100) MΩ	46 µΩ/Ω + 1.2 mΩ 46 µΩ/Ω + 1.2 mΩ 46 µΩ/Ω + 1.2 mΩ 34 µΩ/Ω + 1.8 mΩ 28 µΩ/Ω + 3.5 mΩ 28 µΩ/Ω + 3.5 mΩ 29 µΩ/Ω + 6.3 mΩ 27 µΩ/Ω + 4.0 mΩ 26 µΩ/Ω + 100 mΩ 27 µΩ/Ω + 40 mΩ 26 µΩ/Ω + 1 Ω 33 µΩ/Ω + 3.4 Ω 30 µΩ/Ω + 11 Ω 63 µΩ/Ω + 0.05 kΩ 0.52 mΩ/Ω + 10 kΩ	Fluke 5520A
Resistance[3] – Current Shunt	Up to 80 mΩ (80 to 800) mΩ (0.8 to 1000) Ω	320 µΩ/Ω + 1.3 nΩ 140 µΩ/Ω + 4.7 nΩ 81 µΩ/Ω + 16 µΩ	Fluke 5520A, HP 3458A Opt.002 digital multimeter

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
AC Voltage[3] – Generate			
(0.005 to 2.2) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.022 % + 5.2 µV 0.011 % + 5.2 µV 0.011 % + 5.2 µV 0.038 % + 5.2 µV 0.087 % + 8.1 µV 0.12 % + 15 µV 0.17 % + 29 µV 0.36 % + 29 µV	Fluke 5700A
(2.2 to 22) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.022 % + 5.8µV 0.011 % + 5.8µV 0.011 % + 5.8µV 0.039 % + 5.9µV 0.088 % + 8.1µV 0.12 % + 16 µV 0.18 % + 29µV 0.34 % + 36 µV	
(22 to 220) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.022 % + 9.5 µv 0.011 % + 9.6 µv 0.011 % + 9.4 µV 0.018 % + 62 µV 0.058 % + 130 µV 0.11 % + 37 µV 0.18 % + 41 µV 0.37 % + 93 µV	
(0.22 to 2.2) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.016 % + 48 µV 0.074 % + 14 µV 0.075 % + 11 µV 29 µV/V + 0.70 mV 0.016 % + 0.38 mV 0.046 % + 0.15 mV 0.11 % + 0.42 mV 0.22 % + 1.0 mV	
(2.2 to 22) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.016 % + 0.38 mV 73 µV/V + 0.15 mV 75 µV/V + 0.12 mV 0.011 % + 0.82 mV 0.024 % + 0.47 mV 0.053 % + 1.7 mV 0.14 % + 5.0 mV 0.29 % + 1.0 mV	

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
AC Voltage[3] – Generate (cont)			
(22 to 220) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.17 % + 3.9 mV 80 µV/V + 1.6 mV 82 µV/V + 1.2 mV 0.023 % + 4.2 mV 0.53 % + 9.5 mV 0.17 % + 0.11 V 0.53 % + 0.11 V 1.3 % + 0.22 V	Fluke 5700A
(220 to 750) V	(15 to 50) Hz (0.05 to 1) kHz	0.043 % + 19 mV 77 µV/V + 9.3 mV	
(750 to 1050) V	(0.04 to 10) kHz (10 to 33) kHz	29 µV/V 0.13 mV/V	
(1 to 33) mV	(10 to 45) Hz (0.045 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	99 µV/V + 19 µV 99 µV/V + 19 µV 9.3 µV/V + 250 µV 48 µV/V + 140 µV 0.045 % + 100 µV 0.22 % + 87 µV	
(33 to 330) mV	(10 to 45) Hz (0.045 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.012 % + 0.12 mV 0.012 % + 0.12 mV 13 µV/V + 1.8 mV 35 µV/V + 1.1 mV 0.045 % + 0.43 mV 0.26 % + 0.80 mV	
(0.33 to 3.3) V	(10 to 45) Hz (0.045 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.017 % + 0.71 mV 0.017 % + 0.71 mV 0.027 % + 0.72 mV 0.040 % + 0.74 mV 0.10 % + 1.9 mV 0.28 % + 0.80 mV	
(3.3 to 33) V	(10 to 45) Hz (0.045 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.021 % + 3.0 mV 0.022 % + 7.8 mV 0.024 % + 10 mV 0.019 % + 20 mV 0.22 % + 62 mV	
(33 to 330) V	(0.045 to 1) kHz (1 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.033 % + 19 mV 0.030 % + 32 mV 0.028 % + 11 mV 0.31 % + 20 mV 0.23 % + 63 mV	

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
AC Voltage[3] – Generate (cont)			
(330 to 1020) V	(0.045 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.034 % + 19 mV 0.028 % + 20 mV 0.033 % + 32 mV	Fluke 5520A
(0.1 to 1.0) kV (1.0 to 4.0) kV (4.0 to 9.0) kV	(50 to 60) Hz (50 to 60) Hz (50 to 60) Hz	2.1 V 6.4 V 18 V	HV source monitored by Vitrek 4700
(9.0 to 10) kV	(50 to 60) Hz	0.12 kV	HV source monitored by Vitrek 4700 w/ HVL-150 probe
AC Voltage[3] – Measure			
10 mV	(1 to 40) Hz (40 to 1000) Hz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	790 µV/V + 1.1 µV 98 µV/V + 9.0 µV 170 µV/V + 16 µV 320 µV/V + 32 µV 820 µV/V + 82 µV 10 mV/V + 1.1 mV	HP 3458 opt. 002 digital multimeter
100 mV	(1 to 40) Hz (40 to 1000) Hz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz (1 to 2) MHz	130 µV/V + 11 µV 98 µV/V + 9 µV 170 µV/V + 16 µV 320 µV/V + 32 µV 0.83 mV/V + 82 µV 3.1 mV/V + 0.31 mV 11 mV/V + 1.1 mV 16 mV/V + 1.5 mV	
1 V	(1 to 40) Hz (40 to 1000) Hz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz (1 to 2) MHz	7.9 mV/V + 0.11 mV 4.1 mV/V + 90 µV 4.8 mV/V + 0.16 mV 4.4 mV/V + 0.32 mV 3.8 mV/V + 0.9 mV 8.1 mV/V + 3.1 mV 16 mV/V + 11 mV 20 mV/V + 15 mV	
10 V	(1 to 40) Hz (40 to 1000) Hz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 1) MHz (1 to 2) MHz	0.79 mV/V + 1.1 mV 0.41 mV/V + 0.9 mV 0.50 mV/V + 1.6 mV 0.55 mV/V + 3.2 mV 0.9 mV/V + 8.2 mV 3.2 mV/V + 31 mV 11 mV/V + 0.11 V 16 mV/V + 0.16 V	

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
AC Voltage[3] – Measure (cont.)			
100 V	(1 to 40) Hz (40 to 1000) Hz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz	1.1 mV/V + 24 mV 0.22 mV/V + 22 mV 0.22 mV/V + 22 mV 0.37 mV/V + 37 mV 1.3 mV/V + 0.13 V 4.1 mV/V + 0.41 V 16 mV/V + 1.6 V	
700 V	(10 to 40) Hz (40 to 1000) Hz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.45 mV/V + 37 mV 0.45 mV/V + 37 mV 1.4 mV/V + 42 mV 3.5 mV/V + 42 mV 3.5 mV/V + 42 mV	Vitrek 4700 high voltage multimeter
(1 to 9) kV	(0.01 to 600) Hz	11 V	Vitrek 4700 with HVL-150 high voltage probe
(9 to 20) kV (20 to 40) kV (40 to 60) kV (60.0 to 80) kV (80.0 to 100.0) kV	(30 to 200) Hz (30 to 200) Hz (30 to 200) Hz (30 to 200) Hz (30 to 200) Hz	30 V 54 V 78 V 0.10 kV 0.13 kV	
AC Current[3] – Measure			
Up to 100 µA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 1) kHz	1.9 mA/A + 0.56 µA 0.37 mA/A + 0.58 µA 91 µA/A + 0.58 µA 84 µA/A + 0.57 µA	HP 3458 opt. 002 digital multimeter
(1 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	4.7 mA/A + 24 µA 1.8 mA/A + 24 µA 0.70 mA/A + 24 µA 0.35 mA/A + 24 µA 0.70 mA/A + 24 µA 4.7 mA/A + 47 µA 6.4 mA/A + 170 µA	
(0.1 to 1) A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz (5 to 20) kHz (20 to 50) kHz	4.7 mA/A + 0.24 mA 1.9 mA/A + 0.24 mA 0.92 mA/A + 0.25 mA 2.1 mA/A + 0.25 mA 3.5 mA/A + 0.24 mA 12 mA/A + 0.47 mA	
(1 to 20) A	(2 to 10) kHz 3 Hz to 10 kHz	0.10 % 0.30 %	Fluke Y5020
(20 to 2800) A	1 Hz to 10 kHz	12 mA/A	LEM PR2000

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
AC Current[3] – Generate			
(0.02 to 220) µA	(10 to 20) Hz (20 to 40) Hz (0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.93 mA/A + 30 nA 0.49 mA/A + 25 nA 0.20 mA/A + 20 nA 0.83 mA/A + 50 nA 0.21 % + 0.1 µA	Fluke 5700A
(0.22 to 2.2) mA	(10 to 20) Hz (20 to 40) Hz (0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.93 mA/A + 50 nA 0.49 mA/A + 40 nA 0.19 mA/A + 40 nA 0.82 mA/A + 50 nA 0.21 % + 1 µA	
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz (0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.93 mA/A + 50 nA 0.49 mA/A + 40 nA 0.19 mA/A + 40 nA 0.81 mA/A + 50 nA 0.21 % + 1 µA	
(22 to 220) mA	(10 to 20) Hz (20 to 40) Hz (0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.93 mA/A + 4 µA 0.49 mA/A + 4 µA 0.22 mA/A + 0.4 µA 0.82 mA/A + 50 nA 0.21 % + 1µA	
(0.22 to 2.2) A	(0.02 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.87 mA/A + 40 µA 0.99 mA/A + 0.10 mA 1.2 % + 0.20 mA	
(1.1 to 3) A	(10 to 45) Hz (0.045 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.21 % + 0.10 mA 0.76 mA/A + 0.10 mA 0.70 % + 1.0 mA 2.9 % + 5.0 mA	Fluke 5520A
(3 to 11) A	(45 to 100) Hz (0.1 to 1) kHz (1 to 5) kHz	0.74 mA/A + 2.0 mA 0.12 % + 2.0 mA 3.5 % + 2.0 mA	
(11 to 20.5) A	(45 to 100) Hz (0.1 to 1) kHz (1 to 5) kHz	0.15 % + 5.0 mA 0.18 % + 5.0 mA 3.5 % + 5.0 mA	
(20.5 to 150) A Toroidal	(45 to 65) Hz (65 to 440) Hz	0.41 mA/A 0.96 mA/A	Fluke 5520A, 5500A/coil
Non-Toroidal	45 to 65) Hz (65 to 440) Hz	8.7 mA/A 14 mA/A	

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
AC Current[3] – Generate (cont)			
(150 to 1000) A			
Toroidal	(45 to 65) Hz (65 to 440) Hz	0.41 mA/A 0.96 mA/A	Fluke 5520A, 5500A/coil
Non-Toroidal	(45 to 65) Hz (65 to 440) Hz	7.9 mA/A 13 mA/A	

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
DC Power – Generate[3]	(0.010 89 to 10.89) mW (10.890 to 99) mW (99 to 336.6) W (336.6 to 3060) W (3060 to 20 910) W	0.033 % 0.14 % 0.14 % 0.12 % 0.07 %	Fluke 5520A
AC Watts – Generate[3], (45 to 65) Hz/PF=1	(0.1089 to 0.297) mW (0.297 to 2.97) mW (2.97 to 10.89) mW (10.89 to 72.60) mW (72.60 to 1485) mW (1.485 to 6.765) W (6.765 to 33.66) W (33.66 to 336.6) W (336.6 to 917.9) W (917.9 to 2244) W (2244 to 20 910) W	0.17 % 0.13 % 0.12 % 0.24 % 0.23 % 0.21 % 0.19 % 0.22 % 0.21 % 0.23 % 0.13 %	Fluke 5520A

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
Phase Angle[3] –			
Measure (0 to 359.9999) °	10 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 200) kHz	0.012° 0.017° 0.051° 0.11°	North Atlantic PAV 2250A
Generate (0 to 359.99) °	(10 to 65) Hz (65 to 500) Hz (0.5 to 1) kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.11° 0.26° 0.50° 2.5° 5.0° 10°	Fluke 5520A
Inductance[3] –			
Measure	(0.1 to 10) µH (0.01 to 10) mH 0.01 to 100) mH (0.1 to 10) H (10 to 100) H	0.022 µH 0.21 µH 0.02 H 6.4 H 0.61 H	HP 4284A
Generate			
Fixed points	20 mH 100 mH 200 mH 2 H	0.012 mH 0.054 mH 0.12 mH 1.3 mH	General radio 1482 series inductors
Variable	(1 to 10) mH (10 to 100) mH (0.1 to 1) H (1 to 10) H	9.5 µH 0.81 mH 0.011 H 0.2 H	General radio 1490D
Dissipation Factor – Measure (Df)[3]			Multi-frequency LCR Meter
1 pF to 100 µF	(0.0001 to 10) Df	3.5 % + 1 cts	cts: Counts of LSD

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
Capacitance[3] –			
Measure	(0 to 1) nF (0.001 to 10) µF (0.001 to 10) mF (0.01 to 110) mF	1.1 pF 5.4 nF 0.011 mF 0.28 mF	HP 4284A
Generate	(0.19 to 0.4) nF (0.4 to 1.1) nF (1.2 to 3.3) nF (3.3 to 11) nF (11 to 33) nF (33 to 110) nF (110 to 330) nF (0.33 to 1.1) µF (1.2 to 3.3) µF (3.3 to 11) µF (11 to 33) µF (33 to 110) µF (110 to 330) µF (0.33 to 1.1) mF (1.2 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 100) mF	0.26 % + 13 pF 0.56 % + 12 pF 0.27 % + 13 pF 0.29 % + 120 pF 0.27 % + 140 pF 0.27 % + 390 pF 0.27 % + 1.3 nF 0.27 % + 3.9 nF 0.25 % + 15 nF 0.26 % + 42 nF 0.38 % + 170 nF 0.45 % + 480 nF 0.50 % + 1.4 µF 0.44 % + 4.9 µF 0.26 % + 36 µF 0.78 % + 49 µF 0.83 % + 360 µF 1.1 % + 360 µF	Fluke 5520A
Capacitance[3] – Fixed	1 nF 2 nF 10 nF 100 nF 200 nF 1 µF	0.50 pF 1.1 pF 5.4 pF 7.4 pF 0.10 nF 0.19 nF	General radio 1409 series standard capacitors

Parameter/Equipment	Range	CMC[2, 12] (±)	Comments
Thermocouple Indicating - Simulation[3]			
Type C	(0 to 150) °C (150 to 650) °C (650 to 1000) °C (1000 to 1800) °C (1800 to 2316) °C	0.35 °C 0.28 °C 0.33 °C 0.52 °C 0.87 °C	Fluke 5520A
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.58 °C 0.20 °C 0.18 °C 0.20 °C 0.26 °C	
Type J	(-210 to -30) °C (-30 to 50) °C (50 to 500) °C (500 to 1200) °C	0.30 °C 0.29 °C 0.16 °C 0.23 °C	
Type K	(-200 to -100) °C (-100 to -30) °C (-30 to 120) °C (120 to 1050) °C (1050 to 1371.1) °C	0.35 °C 0.19 °C 0.17 °C 0.15 °C 0.23 °C	
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.42 °C 0.24 °C 0.21 °C 0.20 °C 0.28 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.62 °C 0.41 °C 0.37 °C 0.43 °C	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.53 °C 0.41 °C 0.41 °C 0.49 °C	
Type T	(-250 to -150) °C (-150 to -100) °C (-100 to 0) °C (0 to 400) °C	0.64 °C 0.26 °C 0.18 °C 0.15 °C	

Parameter/Equipment	Range	CMC[2, 12] (±)	Comments
RTD Simulation[3]			
Cu427	100 to 260 °C	0.34 °C	Fluke 5520A
Ni120	(-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.085 °C 0.084 °C 0.15 °C	
Pt 385, 100 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.090 °C 0.093 °C 0.11 °C 0.13 °C 0.14 °C 0.15 °C 0.25 °C	
Pt 385, 200 Ω	(-200 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.046 °C 0.055 °C 0.13 °C 0.14 °C 0.15 °C 0.17 °C	
Pt 385, 500 Ω	(-200 to -80) °C (-80 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.042 °C 0.051 °C 0.061 °C 0.081 °C 0.092 °C 0.12 °C	
Pt 385, 1000 Ω	(-200 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 600) °C (600 to 630) °C	0.031 °C 0.041 °C 0.052 °C 0.062 °C 0.072 °C 0.23 °C	
Pt 3916, 100 Ω	(-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.28 °C 0.058 °C 0.067 °C 0.075 °C 0.093 °C 0.11 °C 0.11 °C 0.12 °C 0.24 °C	
Pt 3926, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.066 °C 0.083 °C 0.11 °C 0.12 °C 0.14 °C	

Parameter/Equipment	Range	CMC[2] (±)	Comments
Oscilloscopes –			
Amplitude – DC Signal[3]			
50 Ω Load	(0 to 6) V	29 mV/V + 0.58 mV	5520A-SC1100 multifunction calibrator w/ oscilloscope opt
1 MΩ Load	(0 to 130) V	590 µV/V + 75 µV	
Amplitude – Square Wave			
50 Ω Load	1 mV_{p-p} to 6.6 V_{p-p}; 10 Hz to 10 kHz	29 mV_{p-p}/V_{p-p} + 75 μV_{p-p}	
1 MΩ Load	1 mV_{p-p} to 130 $V_{p-p;}$ 10 Hz to 10 kHz	280 $\mu V_{p-p}/V_{p-p}$ + 75 μV_{p-p}	
Oscilloscopes – Rise Time			5520A-SC1100 multifunction calibrator w/ oscilloscope opt
0.001 to 2 MHz	(200 to 300) ps	120 ps	
2 to 10 MHz	(250 to 350) ps	140 ps	
Oscilloscopes – Bandwidth[3]			
5 mV to 5.5 V_{p-p}	50 kHz 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	58 mV_{p-p}/V_{p-p} + 470 μV_{p-p} 58 mV_{p-p}/V_{p-p} + 470 μV_{p-p} 70 mV_{p-p}/V_{p-p} + 470 μV_{p-p} 120 mV_{p-p}/V_{p-p} + 470 μV_{p-p}	5520A-SC1100 multifunction calibrator w/ oscilloscope opt
4 mV to 3.5 V_{p-p}	(600 to 1100) MHz	140 mV_{p-p}/V_{p-p} + 470 μV_{p-p}	
Leveled Sine Wave – Frequency	50 kHz to 1.1 GHz	0.58 kHz	
Time Marker	2 ns to 20 ms 50 ms to 5 s	2.9 µs/s + 0.15 ps 1.2 ms/s + 58 µs	

Parameter/Equipment	Range	CMC[2] (±)	Comments
Oscilloscopes –			
Wave Functions - Square, Sine, &Triangle[3]			
50 Ω Load	1.8 mV_{p-p} to 2.5 V_{p-p}. 10 Hz to 10 kHz	35 mV_{p-p}/V_{p-p} + 120 μV_{p-p}	5520A-SC1100 multifunction calibrator w/ oscilloscope opt.
1 MΩ Load	1.8 mV_{p-p} to 55 V_{p-p}. 10 Hz to 10 kHz	35 mV_{p-p}/V_{p-p} + 120 μV_{p-p}	
Pulse Characteristics[3] – Pulse Width	(4 to 500) ns	2.6 ns	
Pulse Period	200 ns to 20 ms	150 ps	
Rise Time – Generate	1 kHz to 2 MHz (200 to 300) ps	120 ps	
	3 to 10 MHz (200 to 350) ps	120 ps	

V. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
Total Harmonic Distortion[3] – Measure	47 Hz to 100 kHz	1.7 %	North Atlantic PAV 2250A

VI. Mechanical

Parameter/Equipment	Frequency	CMC[2, 6] (±)	Comments
Accelerometers[3]			
Voltage Sensitivity (up to 1000) mv/g's	50 Hz to 2 kHz (2 to 10) kHz	3.5 % 5.0 %	Modal Shop 9100D portable

Parameter/Range	Range	CMC[2, 7] (±)	Comments
Scales & Balances[3] –			
Linearity Only	(1.0 to 2.0) lbf (2.0 to 5.0) lbf (5.0 to 10.0) lbf (10.0 to 20.0) lbf (20.0 to 100.0) lbf (100.0 to 200.0) lbf	1.1 x 10-3 lbf 2.0 x 10-3 lbf 3.5 x 10-3 lbf 2.6 x 10-3 lbf 9.2 x 10-3 lbf 1.6 x 10-2 lbf	Reference weights
	(1 to 50) mg (50 to 500) mg (0.5 to 1) g (1 to 5) g (5 to 50) g (50 to 100) g (100 to 200) g (200 to 2000) g (2000 to 6000) g	0.017 mg 0.027 mg 0.055 mg 0.055 mg 0.16 mg 0.64 mg 0.77 mg 6.9 mg 0.14 g	Class 1 weights
Force – Measuring Equipment[3]	(1 to 100) lb	0.052 %	Class F weights
Pneumatic Pressure – Measuring Equipment[3] Compressed Air[3]			
Pressure	Up to 15 psi (15 to 30) psi Up to 45 psi (45 to 90) psi Up to 150 psi (150 to 300) psi Up to 500 psi (500 to 1000) psi Up to 1500 psi (1500 to 3000) psi	0.0015 psi 0.003 psi 0.0046 psi 0.0091 psi 0.015 psi 0.030 psi 0.051 psi 0.10 psi 0.15 psi 0.31 psi	Fluke 6270 Fluke PM500
	(3000 to 6000) psi (6000 to 10 000) psi	8.6 psi 9.5 psi	Fluke 700P31

Parameter/Range	Range	CMC[2, 7] (±)	Comments
Tachometers[3] – Optical	(30 to 250 000) rpm	12 µRPM/RPM + 0.6*R*	Fluke 5520A with LED
Torque – Measure[3]	(1 to 9) lbf·in (5 to 50) lbf·in (50 to 300) lbf·in (10 to 150) lbf·ft (150 to 600) lbf·ft (600 to 1000) lbf·ft	2.1 % 0.64 % 0.38 % 0.35 % 0.31 % 7.1 lbf·ft	Delta Regis DRBT-10 Sturtevant Richmont system 8 w/ transducers Torque transducers. w/ torque analyzer
Mass Flow (Gas) – Measure	(0 to 0.5) slpm (0.5 to 5) slpm (5 to 50) slpm (50 to 100) slpm	0.03 % + 0.0011 slpm 0.26 % + 0.03 slpm 0.26 % + 0.0002 slpm 0.13 % + 0.0002 slpm	Fluke Molbox1+ A700K, Molbloc-L 3E4-VCR-V-Q, Molbloc-L 5E3-VCR-V-Q

VII. Thermodynamics

Parameter/Equipment	Range	CMC[2, 8] (±)	Comments
Humidity[3] – Measuring Equipment	(5 to 95) % RH	0.84 % RH	Rotronic HF53W-ID, Rotronic HC2A probe DOC-00196
Temperature[3] – Measuring Equipment Thermometers	 (-70 to -1) °C (0 to 400) °C (400 to 500) °C	 0.085 °C 0.034 °C 0.079 °C	 BURNS 12005 probe

Parameter/Equipment	Range	CMC[2, 8] (±)	Comments
Temperature[3] – Measuring Equipment (cont)			
Infrared	(-15 to 0) °C (0 to 50) °C (50 to 100) °C (100 to 120) °C	0.96 °C 0.99 °C 1.0 °C 1.2 °C	Fluke 4180 wavelength (8 to 14) µm emissivity 0.95
	(35 to 100) °C (100 to 200) °C (200 to 350) °C (350 to 500) °C	0.82 °C 1.4 °C 2.0 °C 3.0 °C	Fluke 4181 wavelength (8 to 14) µm emissivity 0.95
	(500 to 1000) °C (1000 to 1100) °C (1100 to 1400) °C (1400 to 1500) °C	7 °C 9 °C 10 °C 11 °C	Mikron 335 wavelength (0.65 to 1.8) µm emissivity 1.0
Infrared – Measure[3]			
	(30 to 100) °C (100 to 150) °C (150 to 200) °C (200 to 250) °C	2.4 °C 3.5 °C 4.7 °C 6 °C	Infrared camera Fluke VT04 wavelength (6.5 to 14) µm emissivity 0.01 to 1.0
	(160 to 500) °C (500 to 900) °C (900 to 1300) °C (1300 to 1650) °C	3 °C 4 °C 5 °C 5 °C	Infrared camera Williamson SW-22- 45C-FOV wavelength (2.2) µm emissivity 0.01 to 1.5
Temperature – Measure (Ovens, Chambers, Cells, Furnaces, Autoclaves)	(-200 to 0) °C (0 to 100) °C	0.084 °C 0.031 °C	Fluke 5615-9 probe, Fluke 1524 reference thermometer
	(100 to 300) °C (300 to 420) °C (420 to 500) °C	0.033 °C 0.066 °C 0.078 °C	Burns 12005

VIII. Time & Frequency

Parameter/Equipment	Range	CMC[2, 8] (±)	Comments
Frequency[3] –			
Measure	1 mHz to 3 GHz	30 nHz/Hz	Agilent 53132A
	(3 to 20) GHz	46 nHz/Hz	Agilent 53147A
Timers/Stopwatches[3]	Up to 24 hr.	0.065 s/day	Timometer 4500

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[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] 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 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] Specifications are typical below 10 MHz.

[5] Relative to +16 dBm output.

[6] In the statement of CMC, *L* is the numerical value of the nominal length of the device measured in inches; *R* is instrument resolution; *D* is diagonal length; *S* is each segment greater than the first 36 inch segment; percentages are percentage of reading, unless otherwise indicated.

[7] The measurands stated are generated using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure the measurand in the ranges indicated. CMC are expressed as either a specific value that covers the full range or as a fraction of the reading plus a fixed floor specification.

[8] 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.

[9] Adjustable thread rings are set to applicable specifications using calibrated master set plug gages.

[10] This laboratory meets R205 – Specific Requirements: Calibration Laboratory Accreditation Program for the types of dimensional tests listed above and is considered equivalent to that of a calibration.

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

[12] Simulation is measuring equipment and measure.

Accredited Laboratory

A2LA has accredited

ENI LABS

Fort Wayne, IN

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/NCSL 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 6th day of April 2026.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2147.01
Valid to March 31, 2028

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