



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

INNOCAL
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CALIBRATION

Valid To: October 31, 2017

Certificate Number: 1746.01

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

I. Acoustical

Parameter/Equipment	Range	CMC ² (±)	Comments
Sound Level Meters– Measure ³	250 Hz	0.38 dB	Sound calibrator
	1000 Hz	0.39 dB	
94 dB	250 Hz	0.4 dB	
114 dB	1000 Hz	0.38 dB	

II. Chemical

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
pH – Buffer ³	4 pH 7 pH 10 pH	0.014 pH 0.016 pH 0.016 pH	Standard reference buffer

Parameter/Equipment	Range	CMC ² (±)	Comments
Conductivity – Buffer ³	5 μS 30 μS 84 μS 300 μS 1413 μS 3000 μS 12 880 μS	0.04 μS 0.15 μS 0.4 μS 1.6 μS 6.2 μS 16 μS 0.27 mS	Standard reference buffer
pH Simulation ³	(0 to 14) pH	0.00035 pH	Fluke 5520A

III. Dimensional

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Calipers and Micrometers ³ –	Up to 6 inches (6 to 12) in (12 to 24) in (24 to 60) in	(16 + 22L) μin (14L) μin (20L) μin (110 + 13L) μin)	Gage blocks
Universal Measuring Machines	Up to 6 in (6 to 10) in	(4.4 + 13L) μin 14 μin	
Protractors/Angle Meters/Levels ⁵	(0 to 360)°	0.0079°	Sine plate, gage blocks
Length Measurements – 1D ³	Up to 0.1 in (0.1 to 1) in (1 to 4) in (4 to 6) in (6 to 10) in (10 to 12) in (12 to 24) in	4.9 μin (3.9 + 0.28L) μin (2.8 + 1.5L) μin (5.1 + 0.9L) μin (6 + 0.71L) μin (8.5 + 1.3L) μin (7.8L) μin	Gage blocks and Supermic Gage blocks
Rulers/Tape Measures	Up to 6 in (6 to 12) in (12 to 24) in (2 to 100) ft	(180 + 2.9L) μin (160 + 7.4L) μin (61 + 16L) μin 450 μin per 2 ft	Gage blocks

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Pin/Plug/Thread Wires Gages	Up to 0.1 in (0.1 to 1) in (1 to 3) in (3 to 4) in (4 to 6) in (6 to 10) in	5.1 μin (4 + 0.28L) μin (2.9 + 1.4L) μin (2.7 + 1.5L) μin (5.2 + 0.9L) μin (6 + 0.7L) μin	Gage blocks Gage blocks and Supermic (H28 Handbook)
Radius Gages	Up to 12 in	0.001 in	Optical comparator
Thread Gages	Up to 0.1 in (0.1 to 1) in (1 to 2) in (2 to 10) in	24 μin (24 + 0.05L) μin (24 + 0.3L) μin (24 + 0.4L) μin	Supermic, gage blocks, and thread wires
Height/Depth Gages ³	Up to 12 in (12 to 60) in	(170 + 0.18L) μin (110 + 5.4L) μin	Gage blocks and surface plate
Thickness Gages ³	Up to 1 in	(0.0021 + 0.3L) in	Step blocks
Surface Plate/Block Repeatability ³	Up to 36 in x 36 in	23 μin	Mahr indicator using Union Jack method
Squareness ³	Up to 4 inches (4 to 17) inches	79 μin 120 μin	Granite angle block, surface plate, gage amplifier and master square
Surface Flatness ³ – Optical Flat Surface	Up to 4 in Up to 24 in	3.7 μin 93 μin	Optical flats and Van Keuren monochromatic light Surface plate w/reference std
Parallelism ³	Up to 24 in	46 μin	Surface plate w/reference std

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Gage Blocks	Up to 0.1 in (0.1 to 1) in (1 to 3) in (3 to 4) in (4 to 6) in	4.9 μin (3.8 + 0.35L) μin (2.7 + 1.5L) μin (2.9 + 1.4L) μin (3.3 + 1.3L) μin	Gage blocks CROBLOX/Grade 00 and lab master
Sieves – Opening Size (X/Y) & Wire Diameter (X/Y)	Up to 5 in	(88 + 15L) μin	ASTM E11-13 Optical comparator w/ gage blocks
Optical Comparators ³ (Up to 36 in) – Angles Linear Accuracy	Up to 360° Up to 2 in (2 to 3) in (3 to 4) in (4 to 6) in (6 to 10) in (10 to 20) in (20 to 36) in	0.007° (76 + 0.11L) μin (76 + 0.14L) μin (76 + 0.17L) μin (76 + 0.13L) μin (14 + 0.46L) μin (4.1L) μin (5.3L) μin	Angle blocks Gage blocks standard
Durometers ³ – Types A, B, C, D, O, DO and OO	Indenter extension length Up to 5 kg	830 μin 0.26 g	ASTM D2240 Optical comparator Mass and balance
Angle Blocks	Up to 180°	0.097°	Optical comparator

Parameter/Equipment	Range	CMC ^{2,4,5} (±)	Comments
V-block ³ – Parallelism Squareness Flatness	Up to 24 in Up to 4 inches (4 to 17) inches Up to 24 in	46 μin 79 μin 120 μin 93 μin	Surface plate, reference standard, & master square
Angle Irons ³ – Parallelism Squareness Flatness	Up to 24 in Up to 4 in (4 to 17) in Up to 24 in	46 μin 79 μin 120 μin 93 μin	Surface plate, reference standard, and master square
Ring Gages ³	Up to 0.1 in (0.1 to 1) in (1 to 3) in (3 to 4) in (4 to 6) in (6 to 10) in	5.6 μin (4.7 + 0.24L) μin (3.6 + 1.3L) μin (3.2 + 1.5L) μin (5.6 + 0.9L) μin (6.4 + 0.7L) μin	Gage blocks and Supermic

IV. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of Thermocouple – Generate and Measure ³			
Type B	(250 to 350) °C (350 to 445) °C (445 to 580) °C (580 to 600) °C (600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	1.2 °C 0.87 °C 0.69 °C 0.53 °C 0.35 °C 0.28 °C 0.24 °C 0.26 °C	Ectron 1140A or Fluke 5520A
Type E	(-270 to -250) °C (-250 to -245) °C (-245 to -195) °C (-195 to -155) °C (-155 to -90) °C (-90 to 15) °C (15 to 890) °C (890 to 1000) °C	1.4 °C 0.39 °C 0.21 °C 0.12 °C 0.1 °C 0.08 °C 0.07 °C 0.08 °C	
Type J	(-210 to -180) °C (-180 to -120) °C (-120 to -50) °C (-50 to 1200) °C	0.15 °C 0.12 °C 0.1 °C 0.09 °C	
Type K	(-270 to -255) °C (-255 to -200) °C (-200 to -195) °C (-195 to -115) °C (-115 to -55) °C (-55 to 1000) °C (1000 to 1372) °C	2.6 °C 0.81 °C 0.26 °C 0.14 °C 0.11 °C 0.09 °C 0.1 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of Thermocouple – Generate and Measure ³ (cont)			
Type N	(-270 to -260) °C (-260 to -200) °C (-200 to -140) °C (-140 to -70) °C (-70 to 25) °C (25 to 160) °C (160 to 1300) °C	5.9°C 1.2°C 0.27°C 0.18°C 0.14°C 0.12°C 0.11°C	Ectron 1140A or Fluke 5520A
Type R	(-50 to -30) °C (-30 to 0) °C (0 to 250) °C (250 to 400) °C (400 to 1768) °C	0.77 °C 0.64 °C 0.26 °C 0.27 °C 0.26 °C	
Type S	(-50 to -30) °C (-30 to 0) °C (0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1768) °C	0.73 °C 0.66 °C 0.37 °C 0.29 °C 0.3 °C 0.31 °C	
Type T	(-270 to -255) °C (-255 to -250) °C (-250 to -240) °C (-240 to -210) °C (-210 to -150) °C (-150 to -40) °C (-40 to 100) °C (100 to 400) °C	2.1 °C 0.59 °C 0.5 °C 0.35 °C 0.21 °C 0.14 °C 0.1 °C 0.09 °C	
Type U	(-200 to 0) °C (0 to 600) °C	0.65 °C 0.31 °C	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Electrical Calibration of RTD's – Generate and Measure ³			
Pt 385, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.039 °C 0.054 °C 0.07 °C 0.078 °C 0.093 °C 0.18 °C	Fluke 5520A
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	0.031 °C 0.039 °C 0.093 °C 0.1 °C 0.11 °C 0.12 °C	
Pt 385, 500 Ω	(-200 to -80) °C (-80 to 100) °C (100 to 260) °C (260 to 400) °C (400 to 600) °C (600 to 630) °C	0.031 °C 0.039 °C 0.047 °C 0.062 °C 0.07 °C 0.085 °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	0.023 °C 0.031 °C 0.039 °C 0.047 °C 0.054 °C 0.18 °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	0.19 °C 0.031 °C 0.039 °C 0.047 °C 0.055 °C 0.062 °C 0.07 °C 0.078 °C 0.18 °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	0.039 °C 0.054 °C 0.07 °C 0.078 °C 0.093 °C	
DC Voltage – Generate ³	(0 to 220) mV (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V	0.61 μV + 0.00082 % 1 μV + 0.00072 % 3.6 μV + 0.00072 % 6.5 μV + 0.00072 % 82 μV + 0.00082 % 0.51 mV + 0.00092 %	Fluke 5700A

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
DC Voltage – Measure ³	(0 to 199.999999) mV (0.2 to 1.99999999) V (2 to 19.9999999) V (20 to 199.999999) V (200 to 1000.00000) V (1 to 2) kV (2 to 15) kV	0.11 μV + 0.0005 % 0.42 μV + 0.00035 % 4.3 μV + 0.00036 % 43 μV + 0.00055 % 0.5 mV + 0.00055 % 0.3 V + 0.066 % 7.6 V + 0.033 %	Fluke 8508A High voltage divider Fluke 80F-15

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Voltage (Sine Wave) – Generate ³			
(0.22 to 2.2) mV	(10 to 20) Hz (20 to 40) Hz (40 to 20 000) Hz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	4.6 μV + 0.057 % 4.6 μV + 0.022 % 4.6 μV + 0.011 % 4.6 μV + 0.038 % 7.2 μV + 0.086 % 13 μV + 0.12 % 26 μV + 0.18 % 26 μV + 0.35 %	Fluke 5700A
(2.2 to 22) mV	(10 to 20)Hz (20 to 40)Hz (40 to 20 000) Hz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	5.1 μV + 0.057 % 5.1 μV + 0.022 % 5.1 μV + 0.011 % 5.1 μV + 0.038 % 5.1 μV + 0.087 % 12 μV + 0.12 % 26 μV + 0.18 % 26 μV + 0.35 %	
(22 to 220) mV	(10 to 20) Hz (20 to 40) Hz (40 to 20 000) Hz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	1.3 μV + 0.057 % 8.2 μV + 0.022 % 8.2 μV + 0.011 % 8.2 μV + 0.033 % 26 μV + 0.087 % 26 μV + 0.12 % 36 μV + 0.18 % 82 μV + 0.35 %	
(0.22 to 2.2) V	(10 to 20)Hz (20 to 40)Hz (40 to 20 000) Hz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	0.31 mV + 0.041 % 0.026 mV + 0.017 % 6.1 μV + 0.0077 % 16 μV + 0.013 % 71 μV + 0.026 % 0.13 mV + 0.044 % 0.36 mV + 0.11 % 0.87 mV + 0.23 %	

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Voltage (Sine Wave) – Generate ³ (cont)			
(2.2 to 22) V	(10 to 20)Hz (20 to 40)Hz (40 to 20 000) Hz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	0.82 mV + 0.051 % 0.26 mV + 0.017 % 62 µV + 0.0077 % 0.16 mV + 0.013 % 0.36 mV + 0.026 % 1.5 mV + 0.051 % 4.4 mV + 0.13 % 8.7 mV + 0.28 %	Fluke 5700 w/ amplifier
(22 to 220) V	(10 to 20)Hz (20 to 40)Hz (40 to 20 000) Hz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	8.2mV + 0.051 % 2.6 mV + 0.017 % 0.82 mV + 0.0082 % 3.6 mV + 0.023 % 8.2 mV + 0.051 % 92 mV + 0.16 % 92 mV + 0.48 % 0.19 V + 1.2 %	Fluke 5700
(220 to 250) V	(15 to 40) Hz	16 mV + 0.041 %	
(220 to 1100) V	(40 to 50) Hz (50 to 1000) Hz (1 to 20) kHz (20 to 30) kHz	4.1 mV + 0.01 % 3.6 mV + 0.009 % 6.2 mV + 0.017 % 11 mV + 0.062 %	
(220 to 750) V	(30 to 50) kHz (50 to 100) kHz	11mV + 0.062 % 46 mV + 0.24 %	
AC Voltage (Sine Wave) – Measure ³			
Fixed Points			
200 mV	(1 to 10)Hz (10 to 40) Hz (40 to 100) Hz (100 to 2000) Hz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz	14 µV + 0.017 % 4 µV + 0.014 % 4 µV + 0.0115 % 2 µV + 0.011 % 0.004 mV + 0.012 % 0.008 mV + 0.034 % 20 µV + 0.077 %	Fluke 8508A
2 V	(1 to 10)Hz (10 to 40) Hz (40 to 100) Hz (100 to 2000) Hz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz (300 to 1000) kHz	0.12mV + 0.015 % 20 µV + 0.012 % 20 µV + 0.009 % 20 µV + 0.0075 % 20 µV + 0.011 % 40 µV + 0.022 % 0.2 mV + 0.057 % 2 mV + 0.3 % 20 mV + 1 %	

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Voltage (Sine Wave) – Measure ³ (cont)			
Fixed Points			
20 V	(1 to 10)Hz (10 to 40) Hz (40 to 100) Hz (100 to 2000) Hz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz (300 to 1000) kHz	1.2 mV + 0.015 % 0.2 mV + 0.0115 % 0.2 mV + 0.009 % 0.2 mV + 0.0075 % 0.2 mV + 0.011 % 0.4 mV + 0.022 % 2 mV + 0.057 % 20 mV + 0.3 % 200 mV + 1 %	Fluke 8508A
200 V	(1 to 10)Hz (10 to 40) Hz (40 to 100) Hz (100 to 2000) Hz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz (300 to 1000) kHz	12 mV + 0.015 % 2 mV + 0.012 % 2 mV + 0.009 % 2 mV + 0.0075 % 2 mV + 0.011 % 4 mV + 0.022 % 20 mV + 0.057 % 200 mV + 0.3 % 2 V + 1 %	
1000 V	(1 to 10)Hz (10 to 40) Hz (40 to 10000) Hz (10 to 30) kHz (30 to 100) kHz	70 mV + 0.015 % 21 mV + 0.012 % 20 mV + 0.012 % 40 mV + 0.023 % 0.2 V + 0.058 %	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
DC Current – Generate ³	(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 (2.2 to 11) A (11 to 20.5) A (20 to 100) A (100 to 1000) A	8.2 nA +0.0051 % 8.2 nA + 0.0052 % 82 nA + 0.0051 % 820 nA + 0.0062 % 26 µA + 0.0082 % 490 µA + 0.037 % 57 µA + 0.078 % 18 mA + 0.035 % 0.093 A + 0.027 %	Fluke 5700A Fluke 5520A, Valhalla 2555A w/ 5700A Fluke 5520A

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
DC Current – Measure ³	(0 to 200) µA	0.52 nA + 0.0012 %	Fluke 8508A
	(0.2 to 2) mA	4.9 nA + 0.0012 %	
	(2 to 20) mA	48 nA + 0.0014 %	Fluke 5320A Leeds and Northrup resistors w/8508A
	200 mA	0.8 µA + 0.0048 %	
	(0.2 to 2) A	16 µA + 0.019 %	
	(2 to 20) A	0.4 mA + 0.04 %	
	(20 to 30) A	0.72 A + 3.02 %	
	(10 to 100) A	0.0043 %	

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Current – Generate ³	(10 to 20) Hz	26 nA + 0.072 %	Fluke 5700A
	(20 to 40) Hz	20 nA + 0.036 %	
	(40 to 1000) Hz	16 nA + 0.015 %	
	(1 to 5) kHz	41 nA + 0.062 %	
	(5 to 10) kHz	82 nA + 0.17 %	
	(0.22 to 2.2) mA	(10 to 20) Hz	
(2.2 to 22) mA	(20 to 40) Hz	36 nA + 0.036 %	Fluke 5700A
	(40 to 1000) Hz	36 nA + 0.015 %	
	(1 to 5) kHz	0.41 µA + 0.062 %	
	(5 to 10) kHz	0.82 µA + 0.17 %	
	(10 to 20) Hz	0.41 µA + 0.072 %	
	(20 to 40) Hz	0.36 µA + 0.036 %	
(22 to 220) mA	(40 to 1000) Hz	0.36 µA + 0.015 %	Fluke 5700A
	(1 to 5) kHz	4.1 µA + 0.062 %	
	(5 to 10) kHz	8.2 µA + 0.16 %	
	(10 to 20) Hz	4.1 µA + 0.072 %	
	(20 to 40) Hz	3.6 µA + 0.036 %	
	(40 to 1000) Hz	3.6 µA + 0.015 %	
(0.22 to 2.2) A	(1 to 5) kHz	41 µA + 0.062 %	Fluke 5700A
	(5 to 10) kHz	82 µA + 0.17 %	
	(20 to 1000) Hz	36 µA + 0.067 %	
(2.2 to 11) A	(1 to 5) kHz	82 µA + 0.077 %	Fluke 5700A
	(5 to 10) kHz	0.16 mA + 0.87 %	
	(40 to 1000) Hz	0.18 mA + 0.047 %	
(2.2 to 11) A	(1 to 5) kHz	0.39 mA + 0.097 %	Fluke 5700A
	(5 to 10) kHz	0.77 mA + 0.37 %	
	(40 to 1000) Hz	0.18 mA + 0.047 %	

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Current – Generate ³ (cont)			
(29 to 329.99) μA	(10 to 30) kHz	0.31 μA + 1.3 %	Fluke 5520A
(0.33 to 3.2999) mA	(1 to 5) kHz	0.16 μA + 0.16 %	
	(5 to 10) kHz	0.23 μA + 0.39 %	
	(10 to 30) kHz	0.47 μA + 0.78 %	
(3.3 to 32.999) mA	(1 to 5) kHz	1.6 μA + 0.062 %	
	(5 to 10) kHz	2.3 μA + 0.16 %	
	(10 to 30) kHz	3.1 μA + 0.32 %	
(33 to 329.99) mA	(1 to 5) kHz	39 μA + 0.078 %	
	(5 to 10) kHz	78 μA + 0.16 %	
	(10 to 30) kHz	160 μA + 0.32 %	
(11 to 20.5) A	(45 to 100) Hz	3.9 mA + 0.093 %	
	(100 to 1000) Hz	3.8 mA + 0.12 %	
	(1 to 5) kHz	3.9 mA + 2.4 %	
(20.5 to 1000) A	(45 to 65) Hz	0.1 A + 0.33 %	
	(65 to 440) Hz	0.12 A + 0.92 %	
AC Current- Measure ³			
(0 to 200) μA	(1 to 10 000) Hz	0.02μA + 0.031 %	Fluke 8508A
	(10 to 30) kHz	0.02μA + 0.071 %	
	(30 to 100) kHz	0.02μA + 0.4 %	
(0 to 2) mA	(1 to 10) Hz	0.2 μA + 0.031 %	
	(10 to 10 000) Hz	0.2 μA + 0.03 %	
	(10 to 30) kHz	0.2 μA + 0.071 %	
	(30 to 100) kHz	0.2 μA + 0.4 %	
(0 to 20) mA	(1 to 10) Hz	2 μA + 0.031 %	
	(10 to 10 000) Hz	2 μA + 0.03 %	
	(10 to 30) kHz	2 μA + 0.071 %	
	(30 to 100) kHz	2 μA + 0.4 %	
(0 to 200) mA	(1 to 10) Hz	20 μA + 0.031 %	
	(10 to 10 000) Hz	20 μA + 0.029 %	
	(10 to 30) kHz	20 μA + 0.063 %	
(0 to 2) A	(10 to 2000) Hz	0.2 mA + 0.062 %	
	(2 to 10) kHz	0.2 mA + 0.073 %	
	(10 to 30) kHz	0.2 mA + 0.3 %	

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Current- Measure ³ (cont)			
(0 to 20) A	(10 to 2000) Hz (2 to 10) kHz	2 mA + 0.082 % 2 mA + 0.25 %	Fluke 5320A
(20 to 30) A	20 to 400 Hz	0.56 A + 5%	
Phase - Generate ³			
(0 to 360)°	(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	0.18° 0.3° 0.59° 2.9° 5.8° 12°	Fluke 5520A/SC1100

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Resistance – Generate ^{3,5}			
	(0 to 10.9999) Ω (11 to 32.9999) Ω (33 to 109.9999) Ω (0.11 to 1.099999) kΩ (1.1 to 10.99999) kΩ (11 to 109.99999) kΩ (0.11 to 1.099999) MΩ (1.1 to 3.299999) MΩ (3.3 to 10.99999) MΩ (11 to 32.99999) MΩ (33 to 109.9999) MΩ (110 to 329.9999) MΩ (330 to 1100) MΩ	0.78 mΩ + 0.003 % 1.2 mΩ + 0.002 % 1.1 mΩ + 0.0022 % 1.6 mΩ + 0.0022 % 1.6 mΩ + 0.0022 % 0.16 Ω + 0.0022 % 1.6 Ω + 0.0025 % 23 Ω + 0.0047 % 40 Ω + 0.01 % 2 kΩ + 0.019 % 2.3 kΩ + 0.039 % 75 kΩ + 0.24 % 390 kΩ + 1.2 %	Fluke 5520A
	(1.1 to 10) GΩ (10 to 20) GΩ (20 to 100) GΩ (100 to 1000) GΩ	0.96 MΩ + 0.59 % 0.79 MΩ + 1.2 % 6.2 MΩ + 1.2 % 2.1 %	Resistance decade box
	(1 to 10) TΩ	9 MΩ + 3.2 %	Fluke 5320A

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Resistance – Measure ^{3,5}	(0 to 2) Ω (2 to 20) Ω (20 to 200) Ω (200 to 2000) Ω (2 to 20) kΩ (20 to 200) kΩ (200 to 2000) kΩ (2 to 20) MΩ (20 to 200) MΩ (200 to 2000) MΩ (2 to 20) GΩ	5.3 μΩ + 0.0016 % 14 μΩ + 0.00097 % 50 μΩ + 0.00082 % 0.56 mΩ + 0.0008 % 5 mΩ + 0.000817 % 50 mΩ + 0.0008 % 1Ω + 0.00093 % 100 Ω + 0.0021 % 10 kΩ + 0.012 % 1 MΩ + 0.15 % 15 MΩ + 0.14 %	Fluke 8508A
Resistance- Generate, Fixed Points ^{3,5}	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	52 μΩ 97 μΩ 180 μΩ 290 μΩ 530 μΩ 1.7 mΩ 3.3 mΩ 13 mΩ 25 mΩ 120 mΩ 230 mΩ 1.4 Ω 2.7 Ω 20 Ω 41 Ω 410 Ω 910 Ω 11 kΩ	Fluke 5700A

Parameter/Equipment	Frequency	CMC ^{2,4} (±)	Comments
Capacitance – Generate ³	(0.19 to 3.2999) nF	8 pF + 0.39 %	Fluke 5520A
	(3.3 to 10.9999) nF	7.9 pF + 0.2 %	
	(11 to 109.999) nF	78 pF + 0.2 %	
	(110 to 329.999) nF	0.23 nF + 0.2 %	
	(0.33 to 1.09999) μF	0.81 nF + 0.2 %	
	(1.1 to 3.29999) μF	2.3 nF + 0.2 %	
	(3.3 to 10.9999) μF	1.8 nF + 0.38 %	
	(11 to 32.9999) μF	23 nF + 0.31 %	
	(33 to 109.999) μF	76 nF + 0.36 %	
	(110 to 329.999) μF	0.24 μF + 0.35 %	
	(0.33 to 1.09999) mF	0.76 μF + 0.36 %	
	(1.1 to 3.2999) mF	2.4 μF + 0.35 %	
	(3.3 to 10.9999) mF	7.2 μF + 0.37 %	
	(11 to 32.9999) mF	24 μF + 0.58 %	
	(33 to 110) mF	78 μF + 0.85 %	
Fixed Points	0.0001 μF	120 fF	Precision capacitors
	0.0002 μF	240 fF	
	0.0003 μF	350 fF	
	0.0004 μF	470 fF	
	0.0005 μF	600 fF	
	0.0006 μF	710 fF	
	0.0007 μF	820 fF	
	0.0008 μF	960 fF	
	0.0009 μF	1.1 pF	
	0.001 μF	1.2 pF	
	0.002 μF	2.5 pF	
	0.003 μF	3.7 pF	
	0.004 μF	4.9 pF	
	0.005 μF	5.9 pF	
	0.006 μF	7.1 pF	
	0.007 μF	8.2 pF	
	0.008 μF	9.4 pF	
	0.009 μF	11 pF	
	0.01 μF	12 pF	
	0.02 μF	24 pF	
	0.03 μF	36 pF	
0.04 μF	47 pF		
0.05 μF	58 pF		
0.06 μF	71 pF		
0.07 μF	82 pF		
0.08 μF	94 pF		
0.09 μF	110 pF		
0.1 μF	120 pF		
0.2 μF	250 pF		
0.3 μF	360 pF		
0.4 μF	490 pF		
0.5 μF	610 pF		

Parameter/Equipment	Frequency	CMC ² (±)	Comments
Inductance – Generate ³ Fixed Points 100 µH 200 µH 500 µH 1 mH 100 mH	 (0.1 to 10) kHz (0.1 to 10) kHz (0.1 to 10) kHz (0.1 to 10) kHz (0.1 to 10) kHz	 0.47 µH 0.71 µH 0.76 µH 4.1 µH 0.17 mH	 GenRad 1482x
Distortion – Measure ³ (0 to 99.99) dB	 20 Hz to 20 kHz (20 to 100) kHz	 1.2 dB 2.4 dB	 HP 8903B

V. Electrical/RF Microwave

Parameter/Equipment	Frequency	CMC ² (±)	Comments
RF Power – Measure ³ (+13 to -67) dBm -67 to -57 dBm -57 to -47 dBm -47 to -37 dBm -37 to -27 dBm -27 to -17 dBm -17 to -7 dBm -7 to 3 dBm 3 to 13 dBm -67 to 13 dBm	 0.1 MHz to 6 GHz 0.1 MHz to 6 GHz 0.1 MHz to 2 GHz (2 to 4) GHz (4 to 6) GHz 0.1 MHz to 2 GHz (2 to 4) GHz (4 to 6) GHz 0.1 MHz to 2 GHz (2 to 4) GHz (4 to 6) GHz 0.1 MHz to 2 GHz (2 to 4) GHz (4 to 6) GHz (0.1 to 30) MHz (0.03 to 2) GHz (2 to 4) GHz (4 to 6) GHz (0.1 to 30) MHz (0.03 to 2) GHz (2 to 4) GHz (4 to 6) GHz	 1 dBm 0.18 dBm 0.06 dBm 0.078 dBm 0.14 dBm 0.063 dBm 0.076 dBm 0.14dBm 0.063 dBm 0.076 dBm 0.14 dBm 0.063 dBm 0.076 dBm 0.14 dBm 0.062 dBm 0.074 dBm 0.18 dBm 0.32 dBm 0.063 dBm 0.094 dBm 0.3 dBm 0.5 dBm	 Rohde & Schwarz NRV

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
RF Power – Measure (cont) ³ -67 to 13 dBm	(6 to 8) GHz (8 to 12.4) GHz (12.4 to 15) GHz (15 to 16) GHz (16 to 18) GHz	0.13dBm 0.14 dBm 0.15 dBm 0.18 dBm 0.19 dBm	Rohde & Schwarz NRV
Frequency Response – Measure ³ AC Level Flatness (Up to 3) V	(0.010 to 1000) kHz (1 to 30) MHz (30 to 50) MHz (50 to 70) MHz (70 to 80) MHz (80 to 100) MHz	0.4 % 0.46 % 0.61 % 1.1 % 1.4 % 1.7 %	Precision Measurements EL-2257 w/ 3458A and Fluke 5700A
Amplitude Modulation – Measure ³ Rate: 20 Hz to 10 kHz Depth: to 99%	(0.15 to 10) MHz	2.4 % + 0.015 Hz	Fluke 8901A
Rate: 20 Hz to 50 Hz Depth: to 99%	(0.15 to 10) MHz	2.3 % + 0.074 Hz	
Rate: 50 Hz to 10 kHz Depth: <5%	(0.15 to 10) MHz	3.2 % + 0.027 Hz	
Rate: 50 Hz to 50 kHz Depth: 5 to 99%	(0.01 to 1300) MHz	1.3 % + 0.11 Hz	
Rate: 20 Hz to 50 Hz Depth: to 99%	(0.01 to 1300) MHz	3.5 % + 0.02 Hz	
Rate: 50 kHz to 100 kHz Depth: to 99%	(0.01 to 1300) MHz	3.5 % + 0.02 Hz	
Rate: 20 Hz to 100 kHz Depth: <5%	(0.01 to 1300) MHz	3.2 % + 0.027 Hz	

Parameter/Equipment	Frequency	CMC ^{2,4} (±)	Comments
Frequency Modulation – Measure ³ Rate: 20 Hz to 10 kHz Dev: ≤ 40 KHz peak Rate: 20 Hz to 200 kHz Dev: ≤ 40 KHz peak Rate: 50 Hz to 100 kHz Dev: ≤ 400 KHz peak	(0.25 to 10) MHz (0.01 to 1300) MHz (0.01 to 1300) MHz	0.013 kHz + 2.31 % 0.012 kHz + 5.8 % 0.012 kHz + 1.2 %	Fluke 8901A
Phase Modulation – Measure ³ Rate: 200 Hz to 20 KHz	(0.01 to 1300) MHz	0.36 rad	Fluke 8901A
Oscilloscopes ³ – Square Wave Signal – Generate (1kHz input) 50 Ω 1 MΩ	(1 to 109.99) mV (0.11 to 6.599) V (1 to 109.99) mV (0.110 to 10.999) V (11 to 130) V	32 μV + 0.21 % 32 μV + 0.19 % 32 μV + 0.1 % 32 μV + 0.11 % 960 μV + 0.1 %	Fluke 5520A/SC1100

Parameter/Equipment	Frequency	CMC ^{2,4} (±)	Comments
Oscilloscopes ³ – (cont)			
Leveled Sine Wave Flatness			
5 mV to 5.5 V	50 kHz Reference	0.24 mV + 1.6 %	Fluke 5520A/SC1100
	(0.050 to 100) MHz	0.23 mV + 2.8 %	
5 mV to 3.5 V	(100 to 300) MHz	0.23 mV + 3.1 %	
	(300 to 600) MHz	0.23 mV + 4.7 %	
	(600 to 1100) MHz	0.23 mV + 5.4 %	
Time Marker			
50 Ω Load	(0.050 to 100) MHz	7.7 μV + 1.2 %	
	(100 to 300) MHz	7.8 μV + 1.6 %	
	(300 to 600) MHz	7.8 μV + 3.1 %	
	(600 to 1100) MHz	0.23 mV + 5.4 %	
Edge – Rise Time	(1 to 5) ns	0.0002 %	
	10 ns	0.0002 %	
	(20 to 50) ns	0.0002 %	
	100 ns to 20 ms	0.0002 %	
	50 ms to 5 s	0.51 %	
	≤ 300 ps	79 ps	
Edge – Amplitude	5 mV to 2.5 V	0.16 mV + 1.6 %	

VI. Fluid Quantities

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Airflow – Mass Flow and Correlated, Direct Read ³	(0.002 to 20) LPM	0.23 %	Laminar flow elements
	(20 to 80) LPM	0.22 %	
	(80 to 500) LPM	0.34 %	Volumetric comparison
Air Velocity – Measuring Equipment	(4 to 13) m/s (13 to 40) m/s	0.038 m/s + 0.056 % 0.61 %	Wind tunnel and pressure transducers
Refractive Index-Refractometers ³	(7.5 to 91.75)° Brix	0.02° Brix + 0.012 %	Standard reference materials

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Liquid Volume – Pipettes/Burettes ^{3, 10}	0.1 to 1 µL 1 to 10 µL 10 to 100 µL 100 to 1000 µL 1 to 10 mL 10 to 500 mL 500 to 2000 mL 2000 to 4000 mL	2.4 nL + 1 % 1 nL + 1.2 % 130 nL + 1.1 nL/µL 100 nL + 1.4 nL/µL 1.6 µL/mL 2.1 µL + 1.1 µL/mL 1.4 µL/mL 4.2 µL/mL	Photometric calibrator Gravimetric method and Class 1 mass
Specific Gravity- Hydrometers ³	(0.65 to 0.95) sg (0.95 to 1.05) sg (1.05 to 1.55) sg (1.55 to 2.00) sg	0.00042 sg 0.00014 sg 0.00032 sg 0.00078 sg	Hydrostatic weighing
Viscosity ³	4.5 cP 9 cP 48 cP 96 cP 480 cP 969 cP 4859 cP 11860 cP 30160 cP 59940 cP	0.012 cP 0.027 cP 0.15 cP 0.35 cP 1.8 cP 3.5 cP 22 cP 61 cP 150 cP 290 cP	Reference standard silicone oils

VII. Mechanical

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Barometers ³	(700 to 1100) mBar	0.11 mBar	RPM4/BA100Ks and chamber
Vacuum ³	(0 to 29.2) inHg	0.0009 in Hg + 0.001 %	Quartz reference transducer

Parameter/Equipment	Range	CMC ^{2, 5} (±)	Comments
Pressure ³	(0 to 2) inH ₂ O (2 to 30) inH ₂ O (30 to 100) inH ₂ O (0 to 5) psi (5 to 15) psi (15 to 30) psi (30 to 100) psi (100 to 300) psi (300 to 1000) psi (1000 to 3000) psi (3000 to 10000) psi (10000 to 20000) psi	0.00034 inH ₂ O 0.0011 inH ₂ O + 0.0005 % 0.00012 inH ₂ O + 0.00021 % 0.00048 psi + 0.002 % 0.00016 psi + 0.009 % 0.003 psi 0.01 % 0.03 psi 0.01 % 0.29 psi + 0.0009 % 0.012 % 0.43 psi + 0.02 %	MicroTector deadweight tester Quartz reference transducers
Torque – Measuring Equipment ³	(0.5 to 160) in-oz (10 to 20) in-lb (20 to 600) in-lb (50 to 2000) ft-lb	0.0016 in-oz + 0.027 % 0.0034 in-lb + 0.15 % 0.12 % 0.07 %	Dead weights and torque arm/wheels
Torque – Measure ^{3, 6}	(0.5 to 5) in-oz (5 to 40) in-oz (40 to 400) in-oz (25 to 50) in-lb (50 to 150) in-lb (150 to 400) in-lb (30 to 250) ft-lb (250 to 1000) ft-lb	0.006 in-oz + 0.006 % 1.5 % 0.32 in-oz + 0.51 % 0.32 in-lb + 0.11 % 0.13 in-lb + 0.26 % 0.061 in-lb + 0.31 % 0.16 ft-lb + 0.26 % 0.026 ft-lb + 0.31 %	Watch calibrator, torque transducers
Accelerometer/ Vibration Frequency Response (0 to 20 g) ³	(10 to 30) Hz (30 to 2000) Hz (2000 to 10 000) Hz	4.9 % 3.8 % 5.3 %	Vibration calibrator

Parameter/Equipment	Range	CMC ² (±)	Comments
Balance and Scales ^{3,7} (1 mg to 160 kg)	1 mg 2 mg 5 mg 10 mg 20 mg 50 mg 100 mg 200 mg 500 mg 1 g 2 g 5 g 10 g 20 g 50 g 100 g 200 g 500 g 1 kg 2 kg 5 kg 10 kg 20 kg	6.5 µg 6.4 µg 6.1 µg 6.1 µg 6.1 µg 5.2 µg 7.6 µg 6.2 µg 6.3 µg 20 µg 21 µg 28 µg 40 µg 52 µg 93 µg 0.19 mg 0.38 mg 0.97 mg 2.3 mg 4.6 mg 10 mg 33 mg 64 mg	OIML Ultra Class mass pieces ASTM Class 1 mass pieces
Mass ^{3,7}	1 mg 2 mg 5 mg 10 mg 20 mg 50 mg 100 mg 200 mg 500 mg 1 g 2 g 5 g 10 g 20 g 50 g 100 g 200 g 300 g 400 g 500 g 1 kg 1.5 kg 2 kg 5 kg 10 kg 20 kg	6.2 µg 6.1 µg 6.1 µg 6 µg 6 µg 6 µg 6 µg 6 µg 6 µg 20 µg 20 µg 21 µg 32 µg 50 µg 92 µg 0.19 mg 0.37 mg 0.63 mg 0.7 mg 0.91 mg 1.7 mg 2.5 mg 4.4 mg 10 mg 31 mg 63 mg	OIML Ultra Class

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Force – Measuring Equipment ³	(0 to 250) lbf	0.0054 lbf + 0.0015 %	Dead weights
	(250 to 1000) lbf	0.17 lbf + 0.57 %	CDI Transducers

VIII. Thermodynamics

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Temperature – IR Systems ³	(-15 to 0) °C (0 to 100) °C (100 to 200) °C (200 to 500) °C	0.54 °C + 0.13 % 0.53 °C + 0.14 % 0.41 °C + 0.26 % 0.13 °C + 0.4 %	Blackbody IR calibrator
Temperature – Measuring Equipment and Measure ^{3,8}	-196.0 °C (-80 to 0) °C 0.0 °C (0 to 90) °C (90 to 235) °C (235 to 550) °C (550 to 660) °C (660 to 700) °C (700 to 800) °C (800 to 900) °C (900 to 1000) °C (1000 to 1100) °C (1100 to 1200) °C (1200 to 1300) °C	0.0046 °C 0.0098 °C 0.0045 °C 0.006 °C + 0.00077 % 0.007 °C + 0.0034 % 0.0042 % 0.022 °C + 0.00066 % 0.12 °C 0.27 °C 0.48 °C 0.75 °C 1.1 °C 1.5 °C 2.2 °C	Liquid nitrogen BP apparatus, SPRT Liquid bath and SPRT Ice bath and SPRT Liquid bath and SPRT Salt bath, SPRT Sand bath, SPRT Dry well, T/C
Relative Humidity ^{3,9}	Up to 10 % RH (10 to 95) %RH	0.59 % RH 0.51 % RH	Chilled mirror two-pressure humidity generator

IX. Time & Frequency

Parameter/Equipment	Range	CMC ^{2,5,6} (\pm)	Comments
Stopwatches ³ – Mechanical Electronic	60 s to 720 hr 60 s to 720 hr	0.58 s/day 0.054 s/day	Vibrograf
Stroboscopes ³	(0 to 20 000) fpm (20 000 to 120 000) fpm	0.0031 fpm + 0.00082 % 0.24 fpm + 0.00067 %	Comparison to counter and detector
Optical Tachometers ³	(0 to 100 000) rpm (100 000 to 125 000) rpm (125 000 to 150 000) rpm (150 000 to 175 000) rpm (175 000 to 200 000) rpm	0.00051 rpm + 0.00017 % 0.96 rpm 1.8 rpm 2.6 rpm 3.4 rpm	Comparison to function generator and lamp
Contact Tachometers ³	(60 to 12 000) rpm (12 000 to 24 000) rpm	0.016 rpm + 0.003 % 0.31 rpm + 0.0003 %	Comparison to counter and tachometer tester
Frequency – Measure ³	(0.1Hz to 3.1GHz) (3.1 to 18) GHz	2.1 μ Hz + 0.000021 % 3.9 Hz + 0.68Hz/Hz	Universal counter Spectrum Analyzer
Frequency – Measuring equipment ³	(0.1 Hz to 20MHz)	(80 μ Hz + (12 x 10 ⁻⁹))	3325A Function generator w/5 x 10 ⁻¹¹ oscillator
	(20MHz to 3200MHz)	(0.12 Hz + 0.00024 %)	8648C Generator
Fixed Point	10 MHz	7.7 x 10 ⁻¹¹ MHz	10MHz reference using Rubidium oscillator

¹ This laboratory offers commercial 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 and this laboratory meets A2LA R104 – *General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for these calibrations. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the actual uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.
- ⁴ In the statement of CMC, % is to be read as % of the absolute value of reading unless noted otherwise. *R* indicates unit under test resolution; *L* is the numerical value of the nominal length of the device measured in inches.
- ⁵ Resistance functions can be used to simulate conductivity, dissolved oxygen, RTD, and thermistor functions. Uncertainties are translated into simulated measurement units through known conversion factors.
- ⁶ This lab is not accredited for split-beam torque wrenches.
- ⁷ CMC values listed are for cardinal points. Other values within the range can be obtained using substitution method with uncertainty increased for each value added.
- ⁸ Typical temperature measuring devices are liquid-in-glass (LIG) thermometers, thermocouples, RTDs, thermistors, bimetal thermometers, dry-well baths, liquid baths, ovens, PRTs, temperature transmitters, temperature controllers, temperature dataloggers, temperature recorders, and digital thermometers.
- ⁹ Typical relative humidity devices are thermohygrometers, hygrometers, psychrometers, hygrothermographs, humidity dataloggers, transmitters and recorders.
- ¹⁰ Typical liquid volume devices are pipettes, burettes, dispensers and rain gauges.



Accredited Laboratory

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for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCSLI Z540-1-1994 and any additional program requirements in the field of calibration. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).



Presented this 29th day of September 2015.

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

President & CEO
For the Accreditation Council
Certificate Number 1746.01
Valid to October 31, 2017

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