



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005,
ANSI/NCSL Z540-1-1994 & ANSI/NCSL Z540.3-2006

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CALIBRATION

Valid To: August 31, 2019

Certificate Number: 1877.01

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

I. Acoustics

Parameter/Equipment	Range	CMC ² (±)	Comments
Acoustics Measuring Equipment ⁸ – Microphones (1/8, 1/4, 1/2, 1 in)	250 Hz reference sensitivity	0.50 dB	Modal Shop 9350 Calibrator and reference microphone
	Flatness at 20 Hz	0.67 dB	
Acoustics – Measure Pistonphones, Sound Level Generators 250 Hz	114 dB	0.73 dB	Modal Shop 9350 Calibrator and reference microphone

II. Chemical

Parameter/Equipment	Range	CMC ² (±)	Comments
pH – Measuring Equipment ^{3,8}	(4, 7, 10) units	0.016 units	Buffer solutions

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrolytic Conductivity – Measuring Equipment ^{3,8}	$\approx 10 \mu\text{S/cm}$ $\approx 100 \mu\text{S/cm}$ $\approx 1000 \mu\text{S/cm}$ $\approx 10\,000 \mu\text{S/cm}$	$0.53 \mu\text{S/cm}$ $2.4 \mu\text{S/cm}$ $23 \mu\text{S/cm}$ 0.23mS/cm	Conductivity solutions

III. Dimensional

Parameter/Equipment	Range	CMC ^{2, 7, 9} (±)	Comments
Angle Measuring Equipment – Protractors, Tilt Sensors, etc.	Up to 90 deg	8.7 secs	Sine bar and gage blocks
Angle Measure – Radius Gages, Fixtures, etc.	X or Y up to 4 in X and Y up to 4 in	$0.67 \% + 350 \mu\text{in}$ $0.85 \% + 500 \mu\text{in}$	Mitutoyo optical comparator
Hand Tools ³ – Calipers, Depth Gages, Height Gages, Indicators, Micrometers (ID/OD)	Up to 40 in	$3.6 \mu\text{in/in} + 4.5 \mu\text{in} + 0.6R$	Gage blocks
Tape Measure and Steel Ruler ³	(1 to 12) in (12 to 36) in (3 to 100) ft	$0.008 \text{ in} + 0.2 \text{ in/in}$ $0.0034 \text{ in} + 0.002 \text{ in/in}$ $0.0002 \text{ in} + 0.0043 \text{ in/ft}$	Rigid ruler and gage blocks; no tension applied

IV. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 4, 5, 7} (±)	Comments
DC Voltage ^{3, 8} – Generate	Up 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	6.8 μV/V + 0.40 μV 3.7 μV/V + 0.80 μV 4.9 μV/V + 3.0 μV 4.9 μV/V + 4.3 μV 3.7 μV/V + 48 μV 4.7 μV/V + 0.48 mV	Fluke 5720A
DC Voltage ³ – Measure	Up to 200 mV 200 mV to 2 V (2 to 20) V (20 to 200) V (200 to 1000) V	9.1 μV/V + 0.23 μV 4.3 μV/V + 0.4 μV 4.4 μV/V + 0.7 μV 6.7 μV/V + 0.64 μV 7.1 μV/V + 0.01 mV	Fluke 8508A
DC High Voltage ³ – Measure	(1 to 60) kV (60 to 200) kV	0.02 % 2.4 %	Ross VD60 w/ Agilent 34401A Ross VMP200 w/ Fluke 187
DC Current ⁸ – Generate	Up 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 (20.5 to 150) A (150 to 1000) A	35 μA/A + 6.0 nA 31 μA/A + 7.0 nA 30 μA/A + 41 nA 41 μA/A + 0.71 μA 77 μA/A + 12 μA 0.034 % + 0.48 mA 0.10 % + 0.91 A 0.58 % + 0.16 A 0.60 % + 0.58 A	Fluke 5720A Fluke 5520A Fluke 5520A w/ coil
DC Current – Measure	Up to 200 μA 200 μA to 2 mA (2 to 20) mA (20 to 200) mA 200 mA to 2 A (2 to 20) A	12 μA/A + 4.0 nA 12 μA/A + 15 nA 14 μA/A + 40 nA 48 μA/A + 0.8 μA 0.019 % + 16 μA 0.042 % + 32 μA	Fluke 8508A
DC Power	(0.01 to 330) W (0.33 to 11) kW (11 to 20.5) kW	0.021 % 0.073 % 0.12 %	Fluke 5520A

Parameter/Equipment	Range	CMC ^{2, 4, 7} (\pm)	Comments
Resistance ⁸ – Generate	Up to 10.9999 Ω (11 to 32.9999) Ω (33 to 109.9999) Ω (110 to 329.9999) Ω (0.33 to 1.099999) k Ω (1.1 to 3.299999) k Ω (3.3 to 10.99999) k Ω (11 to 32.99999) k Ω (33 to 109.999) k Ω (110 to 329.999) k Ω	40 $\mu\Omega/\Omega$ + 1.0 m Ω 30 $\mu\Omega/\Omega$ + 2.0 m Ω 28 $\mu\Omega/\Omega$ + 2.0 m Ω 28 $\mu\Omega/\Omega$ + 4.0 m Ω 28 $\mu\Omega/\Omega$ + 13 m Ω 28 $\mu\Omega/\Omega$ + 13 m Ω 28 $\mu\Omega/\Omega$ + 30 m Ω 28 $\mu\Omega/\Omega$ + 0.30 Ω 28 $\mu\Omega/\Omega$ + 0.30 Ω 32 $\mu\Omega/\Omega$ + 2.0 Ω	Fluke 5520A, 4-wire
	(0.33 to 1.09999) M Ω (1.1 to 3.29900) M Ω (3.3 to 10.9999) M Ω (11 to 32.9999) M Ω (33 to 109.9999) M Ω (110 to 329.9999) M Ω (330 to 1100) M Ω	32 $\mu\Omega/\Omega$ + 2.2 Ω 60 $\mu\Omega/\Omega$ + 39 Ω 0.013 % + 63 Ω 0.025 % + 2.5 k Ω 0.050 % + 3.0 k Ω 0.30 % + 0.10 M Ω 1.5 % + 0.50 M Ω	Fluke 5520A, 2-wire
Fixed Points	0 Ω 1 Ω 1.9 Ω 10, 19 Ω 100, 190 Ω 1, 1.9 k Ω 10, 19 k Ω 100, 190 k Ω 1 M Ω 1.9 M Ω 10 M Ω 19 M Ω 100 M Ω	41 $\mu\Omega$ 81 $\mu\Omega/\Omega$ 82 $\mu\Omega/\Omega$ 23 $\mu\Omega/\Omega$ 9.5 $\mu\Omega/\Omega$ 8.5 $\mu\Omega/\Omega$ 8.5 $\mu\Omega/\Omega$ 11 $\mu\Omega/\Omega$ 20 $\mu\Omega/\Omega$ 30 $\mu\Omega/\Omega$ 35 $\mu\Omega/\Omega$ 45 $\mu\Omega/\Omega$ 0.010 %	Fluke 5720A
Resistance – Measure	Up to 2 Ω (2 to 20) Ω (20 to 200) Ω 200 Ω to 2 k Ω (2 to 20) k Ω (20 to 200) k Ω 200 k Ω to 2 M Ω (2 to 20) M Ω (20 to 200) M Ω 200 M Ω to 2 G Ω (2 to 20) G Ω	12 $\mu\Omega/\Omega$ + 0.1 m Ω 7.4 $\mu\Omega/\Omega$ + 24 $\mu\Omega$ 7.6 $\mu\Omega/\Omega$ + 82 $\mu\Omega$ 8.0 $\mu\Omega/\Omega$ + 1.5 m Ω 7.0 $\mu\Omega/\Omega$ + 11 m Ω 7.4 $\mu\Omega/\Omega$ + 72 m Ω 8.4 $\mu\Omega/\Omega$ + 2.0 Ω 10 $\mu\Omega/\Omega$ + 0.11 k Ω 30 $\mu\Omega/\Omega$ + 11 k Ω 500 $\mu\Omega/\Omega$ + 1.4 M Ω 500 $\mu\Omega/\Omega$ + 10 M Ω	Fluke 8508A

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Electrical Calibration of Thermocouple Indicators –			
Type B	(600 to 800) °C (800 to 1550) °C 1550 to 1820) °C	0.35 °C 0.28 °C 0.22 °C	Fluke 7526A
Type C	(0 to 1000) °C (1000 to 1800) °C (1800 to 2000) °C (2000 to 2316) °C	0.16 °C 0.23 °C 0.26 °C 0.35 °C	
Type E	(-250 to -200) °C (-200 to -100) °C (-100 to 0) °C (0 to 600) °C (600 to 1000) °C	0.25 °C 0.12 °C 0.09 °C 0.08 °C 0.1 °C	
Type J	(-210 to -100) °C (-100 to 800) °C (800 to 1200) °C	0.14 °C 0.09 °C 0.1 °C	
Type K	(-250 to -200) °C (-200 to -100) °C (-100 to 500) °C (500 to 800) °C (800 to 1372) °C	0.46 °C 0.16 °C 0.1 °C 0.1 °C 0.13 °C	
Type L	(-200 to -100) °C (-100 to 900) °C	0.1 °C 0.09 °C	
Type N	(-250 to -200) °C (-200 to -100) °C (-100 to 0) °C (0 to 100) °C (100 to 800) °C (800 to 1300) °C	0.73 °C 0.23 °C 0.12 °C 0.11 °C 0.1 °C 0.12 °C	
Type R	(50 to -25) °C (-25 to 0) °C (0 to 100) °C (100 to 400) °C (400 to 600) °C (600 to 1000) °C (1000 to 1600) °C (1600 to 1767) °C	0.55 °C 0.45 °C 0.39 °C 0.28 °C 0.22 °C 0.21 °C 0.19 °C 0.23 °C	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Electrical Calibration of Thermocouple Indicators – (cont)			
Type S	(-50 to -25) °C (-25 to 0) °C (0 to 100) °C (100 to 400) °C (400 to 600) °C (600 to 1000) °C (1000 to 1600) °C (1600 to 1767) °C	0.51 °C 0.43 °C 0.38 °C 0.29 °C 0.23 °C 0.22 °C 0.22 °C 0.26 °C	Fluke 7526A
Type T	(-250 to -200) °C (-200 to -100) °C (-100 to 0) °C (0 to 200) °C (200 to 400) °C	0.35 °C 0.16 °C 0.11 °C 0.09 °C 0.09 °C	
Type U	(-200 to 0) °C (0 to 200) °C (200 to 600) °C	0.16 °C 0.1 °C 0.1 °C	
Electrical Calibration of RTDs ³ Indicating Systems & Measure –			
Pt 385, 100 Ω	(-200 to 80) °C (-80 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 800) °C	0.013 °C 0.02 °C 0.024 °C 0.026 °C 0.033 °C 0.038 °C	Fluke 7526A
Pt 3926, 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	0.013 °C 0.015 °C 0.017 °C 0.022 °C 0.026 °C 0.032 °C	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Electrical Calibration of RTDs ³ Indicating Systems & Measure – (cont)			
Pt 3916, 100 Ω	(-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.01 °C 0.013 °C 0.015 °C 0.017 °C 0.022 °C 0.026 °C 0.031 °C 0.033 °C	Fluke 7526A
Pt 385, 200 Ω	(-200 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 630) °C	0.053 °C 0.056 °C 0.06 °C 0.06 °C 0.069 °C 0.071 °C 0.088 °C	
Pt 385, 500 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.026 °C 0.028 °C 0.034 °C 0.038 °C 0.045 °C	
Pt 385, 1000 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.015 °C 0.018 °C 0.024 °C 0.026 °C 0.033 °C	
Ni 120, 120 Ω	(-80 to 260) °C	0.009 °C	
Cu 427, 10 Ω	(-100 to 260) °C	0.11 °C	
SPRT	(-200 to 660) °C	0.06 °C	

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Voltage ^{3,8} – Generate			
Up to 2.2 mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.022 % + 4.0 μV 85 μV/V + 4.0 μV 75 μV/V + 4.0 μV 0.018 % + 4.0 μV 0.046 % + 5.0 μV 0.090 % + 10 μV 0.12 % + 20 μV 0.25 % + 20 μV	Fluke 5720A
(2.2 to 22) mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.022 % + 4.0 μV 85 μV/V + 4.0 μV 75 μV/V + 4.0 μV 0.018 % + 4.0 μV 0.046 % + 5.0 μV 0.090 % + 10 μV 0.12 % + 20 μV 0.25 % + 20 μV	
(22 to 220) mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.022 % + 12 μV 85 μV/V + 7.0 μV 75 μV/V + 7.0 μV 0.018 % + 7.0 μV 0.042 % + 17 μV 0.075 % + 20 μV 0.12 % + 25 μV 0.25 % + 45 μV	
220 mV to 2.2 V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.022 % + 82 μV 85 μV/V + 82 μV 40 μV/V + 82 μV 70 μV/V + 82 μV 0.011 % + 82 μV 0.034 % + 82 μV 0.090 % + 0.20 mV 0.15 % + 0.32 mV	

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Voltage ^{3,8} – Generate (cont.)			
(2.2 to 22) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.022 % + 0.40 mV 80 μV/V + 0.15 mV 40 μV/V + 50 μV 70 μV/V + 0.10 mV 95 μV/V + 0.20 mV 0.026 % + 0.60 mV 0.090 % + 2.0 mV 0.13 % + 3.2 mV	Fluke 5720A
(22 to 220) V*	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.022 % + 4.0 mV 80 μV/V + 1.5 mV 47 μV/V + 0.61 mV 75 μV/V + 1.0 mV 0.013 % + 2.5 mV 0.080 % + 16 mV 0.42 % + 40 mV 0.70 % + 80 mV	* 220 V range subject to 2.2E7 V- Hz limitation
(220 to 750) V	(30 to 50) kHz (50 to 100) kHz	0.036 % + 11 mV 0.13 % + 45 mV	w/ 5725A
(220 to 1100) V	40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	80 μV/V + 4.1 mV 0.013 % + 6.1 mV 0.036 % + 11 mV	
AC Voltage – Measure			
Up to 200 mV	(1 to 10) Hz (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.012 % + 4.6 μV 91 μV/V + 4.6 μV 0.011 % + 4.6 μV 0.028 % + 4.6 μV 0.064 % + 4.6 μV 0.066 % + 4.6 μV	Fluke 8508A
200 mV to 2 V	(1 to 10) Hz (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.02 % + 23 μV 0.011 % + 23 μV 0.013 % + 23 μV 0.027 % + 23 μV 0.077 % + 23 μV 0.077 % + 23 μV 0.46 % + 23 μV	

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Voltage – Measure (cont)			
(2 to 20) V	(1 to 10) Hz (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.026 % + 0.24 mV 0.011 % + 0.24 mV 0.013 % + 0.24 mV 0.027 % + 0.24 mV 0.076 % + 0.24 mV 0.077 % + 0.24 mV 0.46 % + 0.24 mV	Fluke 8508A
(20 to 200) V	(1 to 10) Hz (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.019 % + 4.2 mV 0.010 % + 4.2 mV 0.012 % + 4.2 mV 0.026 % + 4.2 mV 0.075 % + 4.2 mV 0.076 % + 4.2 mV 0.46 % + 4.2 mV	
(200 to 1050) V	(1 to 10) Hz (10 to 45) Hz 45 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.023 % + 23 mV 0.014 % + 23 mV 0.013 % + 23 mV 0.033 % + 23 mV 0.033 % + 23 mV	
AC High Voltage ⁸ – Measure			
(1 to 42) kVrms	60 Hz	0.26 %	Ross VD60 w/ Agilent 34401A
(42 to 142) kVrms	60 Hz	4.4 %	Ross VMP200 w/ Fluke 187

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Current ⁸ – Generate			
Up to 220 µA	(10 to 20) Hz	0.023 % + 16 nA	Fluke 5720A
	(20 to 40) Hz	0.014 % + 10 nA	
	40 Hz to 1 kHz	0.011 % + 8.0 nA	
	(1 to 5) kHz	0.025 % + 12 nA	
	(5 to 10) kHz	0.090 % + 65 nA	
	(10 to 30) MHz	1.8 % + 0.46 µA	
220 µA to 2.2 mA	(10 to 20) Hz	0.023 % + 40 nA	Fluke 5720A
	(20 to 40) Hz	0.014 % + 36 nA	
	40 Hz to 1 kHz	0.011 % + 36 nA	
	(1 to 5) kHz	0.025 % + 0.11 µA	
	(5 to 10) kHz	0.090 % + 0.65 µA	
	(10 to 30) MHz	1.1 % + 2.9 µA	
(2.2 to 22) mA	(10 to 20) Hz	0.023 % + 0.41 µA	Fluke 5720A
	(20 to 40) Hz	0.014 % + 0.36 µA	
	40 Hz to 1 kHz	0.011 % + 0.36 µA	
	(1 to 5) kHz	0.025 % + 0.56 µA	
	(5 to 10) kHz	0.090 % + 5.0 µA	
	(10 to 30) MHz	0.35 % + 21 µA	
(22 to 220) mA	(10 to 20) Hz	0.023 % + 4.0 µA	Fluke 5720A
	(20 to 40) Hz	0.014 % + 4.0 µA	
	40 Hz to 1 kHz	0.011 % + 3.0 µA	
	(1 to 5) kHz	0.018 % + 4.0 µA	
	(5 to 10) kHz	0.090 % + 10 µA	
	(10 to 30) MHz	0.43 % + 0.36 mA	
220 mA to 2.2 A	20 Hz to 1 kHz	0.024 % + 35 µA	Fluke 5720A
	(1 to 5) kHz	0.039 % + 80 µA	
	(5 to 10) kHz	0.60 % + 0.16 mA	
(2.2 to 11) A	40 Hz to 1 kHz	0.040 % + 0.19 mA	Fluke 5720A
	(1 to 5) kHz	0.085 % + 0.39 mA	
	(5 to 10) kHz	0.33 % + 0.75 mA	
(11 to 20.5) A	(45 to 100) Hz	0.13 % + 7.4 mA	Fluke 5520A
	100 Hz to 1 kHz	0.071 % + 7.4 mA	
	(1 to 5) kHz	3.4 % + 8.6 mA	
(20.5 to 150) A (150 to 350) A	60 Hz (45 to 65) Hz	0.38 % + 0.029 A	Fluke 5520A w/ coil
	60 Hz (45 to 65) Hz	1.0 % + 0.031 A	
(20.5 to 150) A (150 to 1000) A	(65 to 440) Hz	1.0 % + 30 mA	
	(65 to 440) Hz	1.0 % + 0.12 A	

Parameter/Range	Frequency	CMC ^{2,4,7} (±)	Comments
AC Current – Measure			
Up to 200 µA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz	0.040 % + 23 nA 0.039 % + 23 nA 0.084 % + 23 nA	Fluke 8508A
200 µA to 2 mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz	0.036 % + 230 nA 0.033 % + 0.29 µA 0.082 % + 230 nA	
(2 to 20) mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz	0.038 % + 2.0 µA 0.031 % + 2.0 µA 0.072 % + 2.0 µA	
(20 to 200) mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz	0.042 % + 23 µA 0.034 % + 23 µA 0.072 % + 23 µA	
200 mA to 2 A	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz	0.072 % + 0.23 mA 0.086 % + 0.23 mA 0.35 % + 0.23 mA	
(2 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	0.036 % + 23 mA 0.29 % + 23 mA	
AC Power – (45 to 65) Hz; PF=1			Fluke 5520A
330 mV Range	(0.01 to 0.99) W (0.99 to 1.1) W (1.1 to 3.5) W (3.5 to 6.8) W	0.12 % 0.21 % 0.11 % 0.16 %	
330 mA Range			
3.3 A Range			
10.5 A Range			
20.5 A Range	(6.8 to 34) W (34 to 337) W 337 W to 1.1 kW (1.1 to 3.3) kW (3.3 to 11) kW (11 to 20.9) kW	0.11 % 0.11 % 0.22 % 0.21 % 0.09 % 0.17 %	
1020 V Range			
33 mA Range			
330 mA Range			
1.1 A Range			
3.3 A Range			
10.5 A Range			
20.5 A Range			

Parameter/Range	Frequency	CMC ^{2,4,7} (±)	Comments
Capacitance ⁸ – Generate (0.10 to 3.299) nF (0.33 to 10.999) nF (11 to 109.999) nF (110 to 329.99) nF (0.33 to 1.0999) μF (1.1 to 3.2999) μF (3.3 to 10.999) μF (11 to 32.999) μF (33 to 109.99) μF (110 to 329.99) μF (0.33 to 1.0999) mF (1.1 to 3.2999) mF (3.3 to 10.999) mF (11 to 32.999) mF (33 to 110) mF	10 Hz to 10 kHz (10 to 1000) Hz (10 to 1000) Hz (10 to 1000) Hz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz Up to 50 Hz Up to 20 Hz Up to 6 Hz Up to 2 Hz Up to 0.6 Hz Up to 0.2 Hz	0.52 % + 12 pF 0.26 % + 12 pF 0.26 % + 0.12 nF 0.26 % + 0.31 nF 0.26 % + 1.2 nF 0.26 % + 3.1 nF 0.26 % + 12 nF 0.42 % + 31 nF 0.46 % + 0.12 μF 0.46 % + 0.31 μF 0.46 % + 1.2 μF 0.46 % + 3.1 μF 0.46 % + 12 μF 0.78 % + 31 μF 1.2 % + 0.12 mF	Fluke 5520A
Capacitance – Measure 1 pF (expand range) 10 pF (expand range) 100 pF (expand range) 1 nF (expand range) 10 nF (expand range)	500 Hz to 5 kHz (5 to 100) kHz (150 to 500) Hz 500 Hz to 5 kHz (5 to 20) kHz (20 to 100) kHz (50 to 250) Hz 250 Hz to 1 kHz (1 to 20) kHz (20 to 100) kHz (50 to 250) Hz 250 Hz to 20 kHz (20 to 100) kHz (50 to 500) Hz 500 Hz to 2 kHz (2 to 20) kHz (20 to 100) kHz	12 % 1.2 % 12 % 1.2 % 0.12 % 0.46 % 12 % 1.2 % 0.12 % 0.46 % 1.2 % 0.12 % 0.46 % 0.12 % 0.06 % 0.12 % 0.46 %	Fluke PM6304

Parameter/Range	Frequency	CMC ^{2,4,7} (±)	Comments
Capacitance – Measure (cont)			
100 nF (expand range)	(50 to 150) Hz	0.12 %	Fluke PM6304
	150 Hz to 2 kHz	0.06 %	
	(2 to 20) kHz	0.12 %	
	(20 to 100) kHz	0.46 %	
1 μF (expand range)	50 Hz to 2 kHz	0.06 %	
	(2 to 20) kHz	0.12 %	
	(20 to 100) kHz	0.46 %	
10 μF (expand range)	(50 to 1500) Hz	0.06 %	
	(1.5 to 15) kHz	0.12 %	
	(15 to 50) kHz	1.2 %	
	(50 to 100) kHz	12 %	
100 μF (expand range)	(50 to 1500) Hz	0.12 %	
	(1.5 to 15) kHz	1.2 %	
	(15 to 50) kHz	12 %	
(100 to 200) μF	Direct Current	0.065 %	Time-charge method w/ Fluke 5720A & Agilent 3458A
(200 to 330) μF	Direct Current	0.048 %	
(0.33 to 110) mF	Direct Current	0.042 %	

Inductance – Generate & Measure^{3,7} w/ General Radio 1491-G and Fluke PM6304

Frequency (kHz)	100 μH	1 mH	10 mH	100 mH	1 H	10 H
0.1	2.6 %	2.3 %	1.2 %	1.2 %	0.70 %	0.70 %
0.2	2.6 %	2.3 %	1.2 %	1.2 %	0.70 %	0.70 %
0.5	2.6 %	2.3 %	1.2 %	1.2 %	0.70 %	0.70 %
1	2.6 %	2.3 %	1.2 %	1.2 %	0.70 %	0.70 %
2	2.6 %	2.3 %	1.2 %	1.2 %	1.3 %	7.1 %
5	2.6 %	2.3 %	1.2 %	1.4 %	6.2 %	
10	2.6 %	2.3 %	1.2 %	3.3 %		
20	2.4 %	2.3 %	2.0 %	10 %		
50	2.4 %	2.6 %	8.2 %			
100	2.4 %	4.3 %				
200	3.2 %					

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
Phase – Generate 0 to 360°	(1 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz (1 to 5) kHz	0.13° 0.30° 0.58° 2.9°	Fluke 5520A
Phase – Measure 0 to 360°	20 Hz to 10 kHz (>10 to 40) kHz (>40 to 100) kHz	0.088° 0.17° 0.92°	Krohn-Hite 6500A
Distortion ^{3,8}	20 Hz to 20 kHz (20 to 100) kHz	1.0 dB 2.0 dB	Agilent 8903A
Oscilloscopes ³ – Line Sine Wave Amplitude Rise Time Tunnel Diode Pulse 5520 into 50 Ω Time Markers	 50 kHz ref 50 K to 100 MHz (300 to 600) MHz (600 to 1100) MHz 125 ps 2 ns 5 s to 50 ms 50 ms to 20 ns (20 to 1) ns	 2.3 % + 0.35 mV 5 % + 0.36 mV 6.5 % + 0.57 mV 7.5 % + 400 mV 15 ps/ns 33 % 0.6 % + 3 ns 0.006 % + 50 ps 50 ps	Fluke 5520A

V. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
Return Loss ³ (VSWR)	5 MHz to 2 GHz (2 to 12.5) GHz (12.5 to 18) GHz	0.11 dB 0.53 dB 0.85 dB	Agilent 8902A with: Wiltron 60NF50 Wiltron 58A50

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
Power Meter ³ – Power Reference @ 1 mW	50 MHz	1.9 %	Power transfer using Agilent 432A, 478A-H76
Power Accuracy	3 μW to 100 mW	0.29 %	Range calibrator
Relative Power ³ – Measure			
(0 to -10) dB	10 MHz to 26.5 GHz	0.046 dB	Agilent 8902A
(-10 to -20) dB	10 MHz to 26.5 GHz	0.053 dB	
(-20 to -30) dB	10 MHz to 26.5 GHz	0.080 dB	
(-30 to -40) dB	10 MHz to 26.5 GHz	0.098 dB	
(-40 to -50) dB	10 MHz to 26.5 GHz	0.11 dB	
(-50 to -60) dB	10 MHz to 26.5 GHz	0.12 dB	
(-60 to -70) dB	10 MHz to 26.5 GHz	0.13 dB	
(-70 to -80) dB	10 MHz to 26.5 GHz	0.17 dB	
(-80 to -90) dB	10 MHz to 26.5 GHz	0.18 dB	
(-90 to -100) dB	10 MHz to 26.5 GHz	0.19 dB	
(-100 to -110) dB	10 MHz to 26.5 GHz	0.19 dB	
(-110 to -120) dB	10 MHz to 26.5 GHz	0.21 dB	
Absolute Power ³ – Measure			
(-70 to -30) dBm	10 MHz to 18 GHz	2.7 %	Agilent 437B/E4418B: Agilent 8484A, N-type
(-30 to +10) dBm	100 kHz to 4.2 GHz (4.2 to 18) GHz (18 to 26.5) GHz	1.4 % 1.9 % 2.4 %	Agilent 8482A, N-type Agilent 8481A, N-type Agilent 8485A, 3.5 mm
(+10 to +20) dBm	100 kHz to 4.2 GHz (4.2 to 18) GHz (18 to 26.5) GHz	3.3 % 3.5 % 3.8 %	Agilent 8482A, N-type Agilent 8481A, N-type Agilent 8485A, 3.5 mm
Amplitude Modulation ³	(20 to 50) kHz (50 to 100) kHz	1.4 % 3.6 %	Agilent 8902A
Frequency Modulation ³			
Dev: Up to 400 kHz	(20 to 50) Hz 50 Hz to 100 kHz (100 to 200) kHz	5.8 % 1.4 % 5.8 %	Agilent 8902A

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
Phase Modulation ³	200 Hz to 10 kHz	4.7 %	Agilent 8902A
	200 Hz to 20 kHz	3.5 %	

VI. Fluid Quantities

Parameter/Equipment	Range	CMC ^{2,7,8} (±)	Comments
Air Velocity – Anemometers and Flow Meters	Up to 15 m/s	2.8 %	Fluke 743 DMM w/ WTM-1000 and 8455-03 anemometer

VII. Mechanical

Parameter/Equipment	Range	CMC ^{2,7,8} (±)	Comments
Accelerometers – (1 to 10) g	(20 to 99) Hz 100 Hz (101 to 500) Hz 501 Hz to 3 kHz (3 to 10) kHz	2.2 % 2 % 2.1 % 2.3 % 2.7%	VR9500 w/accelerometers
Mass	Up to 200 g (200 to 750) g (750 to 6,000) g (10 to 50) lbs	0.14 mg 2.4 mg 40 mg 0.014 lbs	Multiple substitution method
Balances ³	(1 to 10) mg (10 to 100) mg 100 mg to 1 g (1 to 10) g (10 to 3200) g (3.2 to 15) kg	0.045 % 0.089 % 0.02 % 0.004 % 0.00028 % 0.0002 %	Class 1 weights

Parameter/Equipment	Range	CMC ^{2, 7, 8} (±)	Comments
Scales ³	(1 to 2000) lbs	0.012 %	Class 6 weights
Force Measuring Equipment ³ – Tension & Compression	(0 to 500) lbf	0.06 %	Class F weights
Cable Tensiometers	(10 to 600) lbf	0.32 %	Transducer
Pressure – Precision Measuring Equipment			
Pneumatic	(-14 to 25) psia (0 to 25) psi (700) psia (700) psi (>700 to 1000) psi	9.5 parts in 10 ⁶ 9.8 parts in 10 ⁶ 10 parts in 10 ⁶ 10 parts in 10 ⁶ 60 parts in 10 ⁶	Ruska 2465
Pneumatic ³	15 psia (0 to 15) psi vacuum	0.0081 psia 0.013 psi	Pressure transducer
	(0.1 to 10) inH ₂ O	0.03 inH ₂ O	Fluke 700P01
	(0.14 to 31) psi (10 to 1000) psi	0.01 % 0.01 %	Pneumatic DWT
Hydraulic ³	(50 to 500) psi (500 to 7500) psi (7500 to 15 000) psi	0.017 % 0.018 % 0.024 %	Hydraulic DWT
Pressure – Measure, Dead Weight Testers Pressure	Up to 10,000 psi	0.017 %	Transfer method
Torque Tools ³	5 ozf·in to 2000 lbf·ft	0.30 %	Torque transducers and loader
Torque Transducers ³	5 ozf·in to 2000 lbf·ft	0.057 %	Dead weights and torque arms

VIII. Optical Quantities

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Illuminance Meters	(50 to 10 000) Lux	2.40 %	Transfer method using reference lamps and photometer
Luminance Meters	(5 to 1000) cd/m ²	2.80 %	Transfer method using reference spheres and precision meter

IX. Thermodynamic

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Temperature – Measuring Equipment ³	(-30 to 661) °C	0.015 °C + 0.0036 %	Fluke 518 w/ 5628, 8508A
Temperature – Measure ³	(-197 to 661) °C	0.009 °C + 0.0011 %	Hart 5628 w/ 8508A
Infrared Temperature Measuring Equipment ^{3,6}	(-35 to 150) °C (150 to 500) °C	0.51 °C 0.84 °C + 0.14 m°C/°C	Hart 9133 Hart 9132
Humidity Measuring Equipment –	(10 to 95) % RH	0.73 % RH	Thunder 1200
Humidity – Measure ³	(10 to 80) % RH (80 to 90) % RH	1.4 % RH 2.4 % RH	Vaisala HMI

X. Time & Frequency

Parameter/Equipment	Range	CMC ² (±)	Comments
Frequency – Measuring Equipment ³	0.01 Hz to 26.5 GHz	5 parts in 10 ¹² Hz	Agilent 33220A w/ E4432B
Frequency – Measure ³	DC to 300 MHz (300 to 3000) MHz	5 parts in 10 ¹² Hz	HP 53132A
Stopwatches ³	0.1 s to 24 hr	0.13 s	HP 53132A w/ 33220A
Tachometers ³	(40 to 99 999) rpm	(0.29 + 0.00023x) rpm	Fluke 5520A; x equals measured rpm

XI. Thermodynamic Testing

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Climatic – Freezers, Refrigerators, Incubators, Ovens, Furnaces			
Temperature Uniformity Survey (TUS)	(-270 to 400) °C (400 to 1372) °C	1.2 °C 2.5 °C	AMS 2750E w/ DMM, DAQ scanner and precision thermocouples

¹ This laboratory offers commercial calibration services and field calibration services.

² Calibration and Measurement Capability Uncertainty (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. 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 uncertainty 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 uncertainty.
- ⁴ The stated measured values are determined using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure or generate the measured value in the ranges indicated. CMC's are expressed as either a specific value that covers the full range or as a percent or fraction of the reading plus a fixed floor specification.
- ⁵ DC Voltage is measured with a Fluke 8508A. This capability is suitable for the calibration of devices intended to generate DC Volts in the ranges indicated.
- ⁶ Infrared Temperature is generated with a Hart 9132. This capability is suitable for the calibration of devices intended to measure Temperature in the ranges indicated.
- ⁷ All percentages are percent of reading unless otherwise indicated.
- ⁸ Uncertainty components that can be reasonably attributed to the Unit Under Test have not been utilized in the calculation of the CMC value for this measurement parameter.
- ⁹ In the statement of CMC, R is the resolution of the unit under test.



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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 ANSI/NCSLI Z540-1-1994 and ANSI/NCSLI Z540.3-2006 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 8 January 2009*).



Presented this 25th day of October 2017.

A handwritten signature in blue ink, appearing to be "A. M. ...".

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 1877.01
Valid to August 31, 2019
Revised August 1, 2019

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