



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, 2017

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. Chemical

Parameter/Equipment	Range	CMC ² (±)	Comments
pH – Measuring Equipment ^{3,8}	(4, 7, 10) units	0.016 units	Buffer solutions
Electrolytic Conductivity – Measuring Equipment ^{3,8}	≈10 μS/cm ≈100 μS/cm ≈1000 μS/cm ≈10 000 μS/cm	0.53 μS/cm 2.4 μS/cm 23 μS/cm 0.23 mS/cm	Conductivity solutions

II. Dimensional

Parameter/Equipment	Range	CMC ² (±)	Comments
Hand Tools ³ – Calipers, Depth Gages, Height Gages, Indicators, Micrometers (ID/OD)	Up to 40 in	3.6 μin/in + 4.5 μin	Gage blocks

Parameter/Equipment	Range	CMC ² (±)	Comments
Flatness	Up to 1 in	4.6 μin	Monochromatic light and optical flats
Tape Measure and Steel Ruler ³	(1 to 12) in (12 to 36) in (3 to 24) ft	0.008 in + 0.2 in/in 0.0034 in + 0.002 in/in 0.0026 in + 0.05 in/ft	Rigid ruler and gage blocks; no tension applied

III. 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	7.1 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	5.6 μV/V + 0.23 μV 4.0 μV/V + 0.40 μV 4.1 μV/V + 0.70 μV 6.4 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



Parameter/Equipment	Range	CMC ^{2, 4, 5, 7} (\pm)	Comments
DC Current ⁸ – Generate	Up to 220 μ A (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	35 μ A/A + 6.0 nA 31 μ A/A + 7.0 nA 30 μ A/A + 41 nA 41 μ A/A + 0.71 μ A 77 μ A/A + 12 μ A 0.034 % + 0.48 mA	Fluke 5720A
	(11 to 20.5) A	0.10 % + 0.91 A	Fluke 5520A
	(20.5 to 150) A (150 to 1000)A	0.58 % + 0.16 A 0.3 % + 0.58 A	Fluke 5520A w/ coil
DC Current – Measure	Up to 200 μ A 200 μ A to 2 mA (2 to 20) mA (20 to 200) mA 200 mA to 2 A (2 to 20) A	12 μ A/A + 4.0 nA 12 μ A/A + 15 nA 14 μ A/A + 40 nA 48 μ A/A + 0.8 μ A 0.019 % + 16 μ A 0.042 % + 32 μ A	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
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



Parameter/Equipment	Range	CMC ^{2, 4, 5, 7} (\pm)	Comments
Resistance ⁸ – Generate (cont)	(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 m 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 (4 wire) (2 wire)



Parameter/Equipment	Range	CMC ^{2, 4, 5, 7} (±)	Comments
Electrical Calibration of Thermocouple Indicators –			
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.44 °C 0.34 °C 0.30 °C 0.33 °C	Fluke 5520A
Type C	(0 to 150) °C (150 to 650) °C (650 to 1000) °C (1000 to 1800) °C (1800 to 2316) °C	0.30 °C 0.26 °C 0.31 °C 0.50 °C 0.84 °C	
Type E	(-200 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.50 °C 0.16 °C 0.14 °C 0.16 °C 0.21 °C	
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.27 °C 0.16 °C 0.14 °C 0.17 °C 0.23 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.33 °C 0.18 °C 0.16 °C 0.26 °C 0.40 °C	
Type L	(-200 to -100) °C (-100 to 800) °C (800 to 900) °C	0.37 °C 0.26 °C 0.17 °C	
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.40 °C 0.22 °C 0.19 °C 0.18 °C 0.27 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.57 °C 0.35 °C 0.33 °C 0.40 °C	



Parameter/Equipment	Range	CMC ^{2, 4, 5, 7} (±)	Comments
Electrical Calibration of Thermocouple Indicators – (cont)			
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.47 °C 0.36 °C 0.37 °C 0.46 °C	Fluke 5520A
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.63 °C 0.24 °C 0.16 °C 0.14 °C	
Type U	(-200 to 0) °C (0 to 600) °C	0.56 °C 0.27 °C	
Thermocouple – Measure			
Types E, J, K, and T Type S	(-200 to 1250) °C (-100 to 1450) °C	0.14 °C 0.38 °C	Hart 1560/2566
Electrical Simulation of RTD Indicators –			
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	0.052 °C 0.080 °C 0.091 °C 0.11 °C 0.12 °C 0.23 °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	0.042 °C 0.053 °C 0.12 °C 0.13 °C 0.14 °C 0.16 °C	



Parameter/Equipment	Range	CMC ^{2, 4, 5, 7} (\pm)	Comments
Electrical Simulation of RTD Indicators – (cont)			
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	0.042 °C 0.052 °C 0.062 °C 0.082 °C 0.092 °C 0.11 °C	Fluke 5520A
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	0.034 °C 0.043 °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	0.25 °C 0.042 °C 0.052 °C 0.062 °C 0.071 °C 0.081 °C 0.091 °C 0.10 °C 0.23 °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	0.05 °C 0.071 °C 0.091 °C 0.10 °C 0.12 °C	
PtNi 385, 120 Ω	(-80 to 100) °C (100 to 260) °C	0.081 °C 0.14 °C	
Cu 427, 10 Ω	(-100 to 260) °C	0.30 °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 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 (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	0.036 % + 11 mV 0.080 % + 45 mV 0.13 % + 83 mV 0.42 % + 91 mV 0.70 % + 1.1 V	
(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	w/ 5725A



Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
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	
(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 % + 240 μV 0.011 % + 240 μV 0.013 % + 240 μV 0.027 % + 240 μV 0.076 % + 240 μV 0.077 % + 240 μV 0.46 % + 240 μV	
(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	



Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
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
AC Current ⁸ – Generate			
Up to 220 µA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.023 % + 16 nA 0.014 % + 10 nA 0.011 % + 8.0 nA 0.025 % + 12 nA 0.090 % + 65 nA	Fluke 5720A
220 µA to 2.2 mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.023 % + 40 nA 0.014 % + 36 nA 0.011 % + 36 nA 0.025 % + 0.11 µA 0.090 % + 0.65 µA	
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.023 % + 0.41 µA 0.014 % + 0.36 µA 0.011 % + 0.36 µA 0.025 % + 0.56 µA 0.090 % + 5.0 µA	
(22 to 220) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.023 % + 4.0 µA 0.014 % + 4.0 µA 0.011 % + 3.0 µA 0.018 % + 4.0 µA 0.090 % + 10 µA	
220 mA to 2.2 A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.024 % + 35 µA 0.039 % + 80 µA 0.60 % + 0.16 mA	
(2.2 to 11) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.040 % + 0.19 mA 0.085 % + 0.39 mA 0.33 % + 0.75 mA	
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.12 % + 5.1 mA 0.15 % + 5.1 mA 3.0 % + 5.1 mA	Fluke 5520A
(20.5 to 150) A (150 to 350) A	60 Hz (45 to 65) Hz 60 Hz (45 to 65) Hz	0.31 % + 0.6R 0.32 % + 0.6R	Fluke 5520A w/ coil
(20.5 to 150) A (150 to 1000) A	(65 to 440) Hz (65 to 440) Hz	0.95 % + 35 mA 0.95 % + 0.13 A	



Parameter/Range	Frequency	CMC ^{2,4} (±)	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			
330 mA Range	(0.01 to 0.99) W	0.12 %	
3.3 A Range	(0.99 to 1.1) W	0.21 %	
10.5 A Range	(1.1 to 3.5) W	0.11 %	
20.5 A Range	(3.5 to 6.8) W	0.16 %	
1020 V Range			
33 mA Range	(6.8 to 34) W	0.11 %	
330 mA Range	(34 to 337) W	0.11 %	
1.1 A Range	337 W to 1.1 kW	0.22 %	
3.3 A Range	(1.1 to 3.3) kW	0.21 %	
10.5 A Range	(3.3 to 11) kW	0.09 %	
20.5 A Range	(11 to 20.9) kW	0.17 %	



Parameter/Range	Frequency	CMC ^{2,4} (±)	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	0.51 % + 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 (0.01 to 1) pF (1 to 10) pF (10 to 100) pF (0.1 to 1) nF (1 to 10) nF	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} (±)	Comments
Capacitance – Measure (cont)			
(10 to 100) nF	(50 to 150) Hz 150 Hz to 2 kHz (2 to 20) kHz (20 to 100) kHz	0.12 % 0.06 % 0.12 % 0.46 %	Fluke PM6304
(0.1 to 1) μF	50 Hz to 2 kHz (2 to 20) kHz (20 to 100) kHz	0.06 % 0.12 % 0.46 %	
(1 to 10) μF	(50 to 1500) Hz (1.5 to 15) kHz (15 to 50) kHz (50 to 100) kHz	0.06% 0.12% 1.2 % 12%	
(10 to 100) μF	(50 to 1500) Hz (1.5 to 15) kHz (15 to 50) kHz	0.12 % 1.2 % 12 %	
(100 to 200) μF (200 to 330) μF (0.33 to 110) mF	Direct Current Direct Current Direct Current	0.065 % 0.048 % 0.042 %	
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 ⁸			
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



Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
Oscilloscopes ³ – Line Sine Wave			Fluke 5520A
Amplitude	50 kHz ref 50 K to 100 MHz (300 to 600) MHz (600 to 1100) MHz	2.3 % + 0.35 mV 5 % + 0.36 mV 6.5 % + 0.57 mV 7.5 % + 400 mV	
Rise Time Tunnel Diode Pulse 5520 into 50 Ω	125 ps 2 ns	15 ps/ns 33 %	
Time Markers	5 s to 50 ms 50 ms to 20 ns (20 to 1) ns	0.6 % + 3 ns 0.006 % + 50 ps 50 ps	

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 %					

IV. 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



V. Mechanical

Parameter/Equipment	Range	CMC ^{2,7,8} (±)	Comments
Mass	Up to 200 g (200 to 750) g (750 to 6000) g	0.082 mg 3.3 mg 59 mg	Multiple substitution method
Balances ³	(0.001 to 5) g Up to 10 g Up to 30 g Up to 50 g Up to 100 g Up to 200 g Up to 300 g Up to 500 g Up to 1000 g (1 to 15) kg	0.04 mg 0.06 mg 0.09 mg 0.14 mg 0.3 mg 0.6 mg 0.9 mg 1.4 mg 3 mg 3 mg/kg	Class 1 weights
Scales ³	(1 to 2000) lbs	0.017 %	Class 6 weights
Pressure – Precision Measuring Equipment	(-14 to 25) psia (0 to 25) psi	9.5 parts in 10 ⁶ psi 9.8 parts in 10 ⁶ psi	Ruska 2465
Pneumatic	(2 to 1000) psia (2 to 1000) psi	10 parts in 10 ⁶ psi 10 parts in 10 ⁶ psi	
Pressure – Measuring Equipment ³			
Pneumatic	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
Pressure – Measuring Equipment ³			
Hydraulic	(50 to 500) psi (500 to 7500) psi (7500 to 15 000) psi	0.017 % 0.018 % 0.024 %	Hydraulic DWT



Parameter/Equipment	Range	CMC ^{2, 7, 8} (±)	Comments
Pressure – Dead Weight Testers Pressure	Up to 10,000 psi	0.017 %	Transfer method
Force Measuring Equipment ³ – Tension & Compression	(0 to 500) lbf	0.06 %	Class F weights
Torque Tools ³	(20 to 400) ozf·in (24 to 50) lbf·in (50 to 400) lbf·in (400 to 1000) lbf·in (83 to 125) lbf·ft (125 to 250) lbf·ft (250 to 600) lbf·ft (600 to 1000) lbf·ft (1000 to 2000) lbf·ft	0.63 in·ozf + 0.3 % 0.069 in·lbf 0.42 in·lbf 0.2 in·lbf 0.14 ft·lbf 0.094 ft·lbf 0.5 ft·lbf 1.1 ft·lbf 1.3 ft·lbf	Torque transducers and loader
Power Torque Tools ³	(20 to 400) ozf·in (24 to 50) lbf·in (50 to 400) lbf·in (400 to 1000) lbf·in (80 to 125) lbf·ft (125 to 250) lbf·ft	0.056 in·ozf + 0.1 % 0.0013 in·lbf + 0.1 % 0.045 in·lbf + 0.1 % 0.029 in·lbf + 0.1 % 0.055 ft·lbf + 0.08 % 0.0062 ft·lbf + 0.1 %	Torque transducers loader and joint rate simulators
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
Torque Transducers ³	(10 to 400) ozf·in (24 to 50) lbf·in (50 to 400) lbf·in (400 to 1000) lbf·in (83 to 125) lbf·ft (125 to 250) lbf·ft (250 to 600) lbf·ft (600 to 1000) lbf·ft (1000 to 2000) lbf·ft	0.055 in·ozf + 0.078 % 0.0027 in·lbf + 0.0076 % 0.058 in·lbf + 0.0031 % 0.058 in·lbf + 0.0031 % 0.014 ft·lbf + 0.0062 % 0.0075 ft·lbf + 0.025 % 0.011 ft·lbf + 0.015 % 0.1 ft·lbf + 0.0092 % 0.081 ft·lbf + 0.014 %	Dead weights and torque arms



VI. 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}	Ambient to 500 °C	0.84 °C + 0.14 m°C/°C	Hart 9132
Humidity Measuring Equipment –	(10 to 95) % RH	0.002 %X + 0.63 % RH	Thunder 1200 where X is the observed reading
Humidity Measuring Equipment – Calibration of Humidity Probes ³	(10 to 97.4) % RH	1.8 % RH	ASTM E104
Humidity – Measure ³	(10 to 80) % RH (80 to 90) % RH	1.4 % RH 2.4 % RH	Vaisala HMI

VII. Time & Frequency

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Sine Wave Frequency – Generate ³	0.01 Hz to 2 kHz 2 kHz to 0.5 MHz (0.5 to 250) MHz (250 to 500) MHz (500 to 1100) MHz	2.9 µHz/Hz 2.9 µHz/Hz 2.9 µHz/Hz 2.9 µHz/Hz 2.9 µHz/Hz	Fluke 5520A
Sine Wave Frequency – Measure	30 Hz to 1.0 MHz (1 to 225) MHz	0.24 µHz/Hz 0.2 µHz/Hz	HP 53132



Parameter/Equipment	Range	CMC ^{2,7} (\pm)	Comments
Time Interval – A to B	10 ns to 10 ⁵ s	2.9 parts in 10 ¹² + 1.2 ns	HP 53132
Frequency – Measuring Equipment ³	0.01 Hz to 250 kHz 250 kHz to 3GHz	20 μ Hz/Hz + 370 pHz 3.1 parts in 10 ¹⁰ + 0.012 Hz	Agilent 33220A w/ E4432B
Frequency – Measure ³	(DC to 300) MHz (300 to 3000) MHz	5.9 parts in 10 ⁸ Hz 1.6 Hz	HP 53132A
Frequency – Measure ³	10 MHz	1 parts in 10 ¹² Hz	GPS w/ HP 53132
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

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 measurands stated are generated with the Fluke series calibrators. This capability is suitable for the calibration of the devices intended to measure the stated measurand in the ranges indicated. Calibration



and Measurement Capability (CMC) uncertainties are expressed as either a specific value that covers the full range or as output plus one year floor specification where defined.

- 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.

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Accredited Laboratory

A2LA has accredited

CALIBRATION SOLUTIONS, A TRESICAL COMPANY

Cornelius, NC

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 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 29th day of June 2015.

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President and CEO
For the Accreditation Council
Certificate Number 1877.01
Valid to August 31, 2017
Revised July 25, 2017

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