



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

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CALIBRATION

Valid To: May 31, 2021

Certificate Number: 1741.05

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations<sup>1, 12</sup>:

I. Chemical

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
pH Meters <sup>3</sup>	4 pH 7 pH 10 pH	0.03 pH units 0.04 pH units 0.07 pH units	Standard pH solutions
Conductivity Meters <sup>3</sup>	1 µS/cm 5 µS/cm 10 µS/cm 100 µS/cm 1000 µS/cm	0.56 µS/cm 0.56 µS/cm 0.56 µS/cm 2.2 µS/cm 5.2 µS/cm	Standard conductivity solutions

II. Dimensional

Parameter/Equipment	Range	CMC <sup>2, 5</sup> (±)	Comments
Cylindrical Measure – Plain Rings	Up to 4 in	(26 + 3.5L) µin	P & W Labmaster™ w/ XX master rings
Pins, Plain Plugs, Discs, Spheres – External Diameter	Up to 4 in	(11 + 5L) µin	P & W Labmaster™ w/ gage blocks

Parameter/Equipment	Range	CMC <sup>2,5</sup> ( $\pm$ )	Comments
Calipers <sup>3</sup>	Up to 80 in	$(5.7 + 9.4L) \mu\text{in} + 0.6R$	Gage blocks
Micrometers <sup>3</sup> – Outside	Up to 80 in	$(5.7 + 9.4L) \mu\text{in} + 0.6R$	Gage blocks
Linear Indicators <sup>3</sup> – Dial and Test	Up to 4 in	$(5.9 + 9.1L) \mu\text{in} + 0.6R$	Gage blocks
Height Gages <sup>3</sup>	Up to 48 in	$(24 + 2L) \mu\text{in} + 0.6R$	Gage blocks, surface plate
Steel Rules <sup>3</sup>	Up to 72 in	$(1.5 + 10L) \mu\text{in} + 0.6R$	Gage blocks
Tape Measures <sup>3</sup>	Up to 25 ft	$(1.5 + 10L) \mu\text{in} + 0.6R$	Gage blocks
Angle Indicators and Protractors <sup>3</sup>	30°, 45°, 60°, 75°, 90°	0.03°	Angle block set
Angle Gages	Up to 90°	0.16°	Vision machine
Hand Tools <sup>3</sup> – Depth Gages, Snap Gages, Thickness Gages	Up to 4 in	$(5.9 + 9.1L) \mu\text{in} + 0.6R$	Gage blocks
Feeler Gages	Up to 1 in	75 $\mu\text{in}$	Digital micrometer
Optical Comparators <sup>3</sup>			
Magnification	10× to 250×	0.014 in	Grid plate, glass master and scale
X – Y Linearity	Up to 12 in	150 $\mu\text{in}$	
Angle <sup>9</sup>	Up to 90°	0.1°	Angle block set
Vision Systems <sup>3</sup>			
X-Y Linearity	Up to 18 in	$(52 + 2.9L) \mu\text{in}$	Grid plates
Z Axis	Up to 4 in	60 $\mu\text{in}$	Gage blocks

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
Sieves – Average Opening Average Wire Diameter	(0.1 to 30) mm (0.1 to 5) mm	5.9 μm 5.9 μm	ASTM E11 vision system
Surface Plates <sup>3</sup> – Repeatability Only/Local Flatness Flatness	0.002 in Up to 60DL (>60 to 120DL)	33 μin (31 + 0.2DL) μin (30 + 0.3DL) μin	Repeat-o-meter Federal level systems
Diameter/Radius/ Fixture Gages – Diameter Radius Length	Up to 12.0 in Up to 12.0 in Up to 12.0 in	(200 + 6L) μin (200 + 6L) μin (200 + 6L) μin	Vision machine
Roughness Specimens Ra	(2 to 500) μin	3.4 μin	Mitutoyo CV-500 surface analyzer

### III. Dimensional Testing/Calibration<sup>1</sup>

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
Surface Finish Measure – Ra	(2 to 500) μin	3.4 μin	Mitutoyo CV-500 surface analyzer

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
Length <sup>8</sup> –  X Axis Y Axis Z Axis	Up to 25 in (650 mm) Up to 30 in (750 mm) Up to 20 in (500 mm)	(190 + 7.6L) μin	CMM
Volumetric <sup>3</sup>	Up to 20 in	(200 + 6.7L) μin	CMM
X-Y Measurements	3 in x 6 in 12 in x 12 in	(280 + 5.8L) μin (200 + 6L) μin	Star Lite 150 vision system sprint- 300

#### IV. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2,4,6</sup> (±)	Comments
DC Voltage – Measure <sup>3</sup>	(0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1000) V  (Up to 10) kV (10 to 100) kV	11 μV/V + 3 μV 10 μV/V + 0.3 μV 10 μV/V + 0.05 μV 12 μV/V + 0.3 μV 27 μV/V + 0.1 μV  0.05 % + 0.03 V 0.07 % + 0.3 V	HP 3458A  Vitretek 4700 w/ HVL-100
DC Voltage – Generate <sup>3</sup>	(0 to 330) mV 330 mV to 3.3 V (3.3 to 33) V (33 to 330) V (100 to 1020) V	25 μV/V + 1 μV 14 μV/V + 2 μV 15 μV/V + 15 μV 22 μV/V + 150 μV 22 μV/V + 1.5 mV	Fluke 5522A
DC Current – Measure <sup>3</sup>	(0 to 100) nA 100 nA to 1 μA (1 to 10) μA (10 to 100) μA 100 μA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	35 μA/A + 0.04 nA 25 μA/A + 0.04 nA 25 μA/A + 0.1 nA 25 μA/A + 0.8 nA 25 μA/A + 5 nA 25 μA/A + 50 nA 40 μA/A + 0.5 μA 0.012 % + 10 μA	HP 3458A

Parameter/Equipment	Range	CMC <sup>2,4,6</sup> (±)	Comments
DC Current – Measure <sup>3</sup> (cont)	(1 to 20) A	0.017 %	Fluke Y5020 w/ HP 3458A
	(20 to 100) A	0.25 %	Empro shunt w/ HP 3458A
DC Current – Generate <sup>3</sup>	(0 to 330) µA	0.018 % + 0.02 µA	Fluke 5522A
	(0 to 3.3) mA	0.012 % + 0.05 µA	
	(0 to 33) mA	0.013 % + 0.25 µA	
	(0 to 330) mA	0.014 % + 2.5 µA	
	(0 to 1.1) A	0.024 % + 40 µA	
	(1.1 to 3) A	0.046 % + 40 µA	
	(0 to 11) A	0.06 % + 500 µA	
	(11 to 21) A	0.12 % + 750 µA	
DC Clamp-On Meters <sup>3</sup> – (Toroidal)	(20.5 to 1000) A	0.39 % + 0.5 A	Fluke 5522A w/5500 coil
	(Non-Toroidal)	(20.5 to 1000) A	
DC Power – Generate <sup>3</sup>  33 mV to 1020V	(0.01 to 330) W (0.33 to 3.3) kW (3.3 to 20.5) kW	(0.33 to 329.99) mA	0.03 %
		(0.33 to 2.9999) A	0.03 %
		(3 to 20.5) A	0.09 %
Resistance – Measure <sup>3</sup>	(0 to 10) Ω	18 µΩ/Ω + 50 µΩ	HP 3458A
	(10 to 100) Ω	15 µΩ/Ω + 0.5 mΩ	
	100 Ω to 1kΩ	14 µΩ/Ω + 0.5 mΩ	
	(1 to 10) kΩ	13 µΩ/Ω + 5 mΩ	
	(10 to 100) kΩ	13 µΩ/Ω + 50 mΩ	
	100 kΩ to 1 MΩ	18 µΩ/Ω + 2 Ω	
	(1 to 10) MΩ	53 µΩ/Ω + 100 Ω	
	(10 to 100) MΩ	0.051 % + 1 kΩ	
	100 MΩ to 1 GΩ	0.5 % + 10 kΩ	

Parameter/Equipment	Range	CMC <sup>2,4,6</sup> (±)	Comments
Resistance – Generate <sup>3</sup>	(0 to 11) Ω (11 to 33) Ω (33 to 110) Ω 110 Ω to 1.1 kΩ (1.1 to 11) kΩ (11 to 110) kΩ 110 kΩ to 1.1 MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ (330 to 1100) MΩ	49 μΩ/Ω + 0.001 Ω 51 μΩ/Ω + 0.0015 Ω 34 μΩ/Ω + 0.0014 Ω 34 μΩ/Ω + 0.002 Ω 34 μΩ/Ω + 0.02 Ω 34 μΩ/Ω + 0.2 Ω 39 μΩ/Ω + 2 Ω 73 μΩ/Ω + 30 Ω 0.014 % + 50 Ω 0.03 % + 2.5 kΩ 0.06 % + 3 kΩ 0.36 % + 100 kΩ 1.8 % + 500 kΩ	Fluke 5522A
Insulation Resistance <sup>3</sup> –	1 M, 10 M, 100 MΩ, 1 GΩ, 10 G, 100 G	1.2 %	Local resistor set

Parameter/Range	Frequency	CMC <sup>2,4</sup> (±)	Comments
Capacitance – Generate <sup>3</sup>			
(220 to 399.9) pF	(10 to 10 000) Hz	0.88 % + 10 pF	Fluke 5522A
(0.4 to 1.0999) nF	(10 to 10 000) Hz	0.6 % + 0.01 nF	
(1.1 to 3.2999) nF	(10 to 3000) Hz	0.6 % + 0.01 nF	
(3.3 to 10.9999) nF	(10 to 1000) Hz	0.31 % + 0.1 nF	
(11 to 109.999) nF	(10 to 1000) Hz	0.31 % + 0.1 nF	
(110 to 329.999) nF	(10 to 1000) Hz	0.31 % + 0.3 nF	
(0.33 to 1.099 99) μF	(10 to 600) Hz	0.31 % + 1 nF	
(1.1 to 3.29999) μF	(10 to 300) Hz	0.31 % + 3 nF	
(3.3 to 10.9999) μF	(10 to 150) Hz	0.31 % + 10 nF	
(11 to 32.9999) μF	(10 to 120) Hz	0.49 % + 30 nF	
(33 to 109.999) μF	(10 to 80) Hz	0.55 % + 100 nF	
(110 to 329.999) μF	(0 to 50) Hz	0.55 % + 300 nF	
(0.33 to 1.099 99) mF	(0 to 20) Hz	0.55 % + 1 μF	
(1.1 to 3.299 99) mF	(0 to 6) Hz	0.55 % + 3 μF	
(3.3 to 10.9999) mF	(0 to 2) Hz	0.56 % + 10 μF	
(11 to 32.9999) mF	(0 to 0.6) Hz	0.91 % + 30 μF	
(33 to 110) mF	(0 to 0.2) Hz	1.4 % + 100 μF	

Parameter/Range	Frequency	CMC <sup>2,4,6</sup> (±)	Comments
AC Voltage – Generate <sup>3</sup>			
(1 to 33) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.1 % + 6 μV 0.021 % + 6 μV 0.027 % + 6 μV 0.12 % + 6 μV 0.42 % + 12 μV 0.96 % + 50 μV	Fluke 5522A
(33 to 330) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.036 % + 8 μV 0.018 % + 8 μV 0.02 % + 8 μV 0.042 % + 8 μV 0.096 % + 32 μV 0.24 % + 70 μV	
330 mV to 3.3 V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.036 % + 50 μV 0.018 % + 60 μV 0.023 % + 60 μV 0.036 % + 50 μV 0.084 % + 130 μV 0.29 % + 600 μV	
(3.3 to 33) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.036 % + 650 μV 0.018 % + 600 μV 0.029 % + 600 μV 0.042 % + 600 μV 0.11 % + 1.6 mV	
(33 to 330) V	45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.023 % + 2 mV 0.024 % + 6 mV 0.03 % + 6 mV 0.036 % + 6 mV 0.24 % + 50 mV	
(330 to 1020) V	45 Hz to 10 kHz	0.036 % + 10 mV	

Parameter/Range	Frequency	CMC <sup>2,4,6</sup> (±)	Comments
AC Voltage – Measure <sup>3</sup>			
Up to 10 mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.031 % + 0.03 % of rng 0.021 % + 0.01 % of rng 0.031 % + 0.01 % of rng 0.11 % + 0.01 % of rng 0.51 % + 0.01 % of rng 4.1 % + 0.02 % of rng	HP 3458A
10 mV to 10 V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.008 % + 0.004 % of rng 0.008 % + 0.002 % of rng 0.015 % + 0.002 % of rng 0.031 % + 0.002 % of rng 0.081 % + 0.002 % of rng 0.31 % + 0.01 % of rng	
(10 to 100) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.021 % + 0.004 % of rng 0.021 % + 0.002 % of rng 0.021 % + 0.002 % of rng 0.036 % + 0.002 % of rng 0.13 % + 0.002 % of rng 0.41 % + 0.01 % of rng	HP 3458A
(100 to 600) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.41 % + 0.004 % of rng 0.41 % + 0.002 % of rng 0.61 % + 0.002 % of rng 0.13 % + 0.002 % of rng 0.31 % + 0.002 % of rng	
Up to 10 kV	(45 to 60) Hz	0.1 % + 0.6 V	Vitretek 4700 w/ HVL-100
(10 to 75) kV	(45 to 60) Hz	0.1 % + 0.6 V	



Parameter/Range	Frequency	CMC <sup>2,4</sup> (±)	Comments
AC Current – Generate <sup>3</sup>			
(0 to 0.33) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.24 % + 0.1 µA 0.18 % + 0.1 µA 0.15 % + 0.1 µA 0.36 % + 0.15 µA 0.96 % + 0.2 µA 1.9 % + 0.4 µA	Fluke 5522A
(0.33 to 3.3) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.24 % + 0.15 µA 0.15 % + 0.15 µA 0.12 % + 0.15 µA 0.24 % + 0.2 µA 0.6 % + 0.3 µA 1.2 % + 0.6 µA	
(3.3 to 33) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.22 % + 2 µA 0.11 % + 2 µA 0.05 % + 2 µA 0.1 % + 2 µA 0.24 % + 3 µA 0.48 % + 4 µA	
(33 to 330) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.22 % + 20 µA 0.11 % + 20 µA 0.05 % + 20 µA 0.12 % + 50 µA 0.24 % + 100 µA 0.48 % + 200 µA	
(0.33 to 1.1) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.22 % + 100 µA 0.06 % + 100 µA 0.72 % + 1 mA 3 % + 5 mA	
(1.1 to 3.0) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.22 % + 100 µA 0.073 % + 100 µA 0.72 % + 1 mA 3 % + 5 mA	
(3.0 to 11) A	45 Hz to 1 kHz (1 to 5) kHz	0.2 % + 2 mA 3.6 % + 2 mA	
(11 to 20.5) A	45 Hz to 1 kHz (1 to 5) kHz	0.18 % + 5 mA 3.6 % + 5 mA	

Parameter/Range	Frequency	CMC <sup>2, 4, 6</sup> (±)	Comments
AC Clamp-On Meters <sup>3</sup> – (10 to 150) A			Fluke 5522A
Toroidal	(45 to 65) Hz (65 to 440) Hz	0.49 % + 0.025 A 1 % + 0.027 A	
Non-Toroidal	(45 to 65) Hz (65 to 440) Hz	0.76 % + 0.25 A 1.3 % + 0.25 A	
(150 to 1025) A			Fluke 5520A w/ 5500 coil
Toroidal	(45 to 65) Hz (65 to 440) Hz	0.49 % + 0.09 A 1 % + 0.1 A	
Non-Toroidal	(45 to 65) Hz (65 to 440) Hz	0.76 % + 0.9 A 1.3 % + 0.9 A	
AC Current – Measure <sup>3</sup>			
(0 to 100) µA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.41 % + 0.03 % of rng 0.16 % + 0.03 % of rng 0.07 % + 0.03 % of rng 0.07 % + 0.03 % of rng	HP 3458A
(1 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.41 % + 0.02 % of rng 0.16 % + 0.02 % of rng 0.07 % + 0.02 % of rng 0.04 % + 0.02 % of rng 0.07 % + 0.02 % of rng 0.41 % + 0.04 % of rng 0.56 % + 0.15 % of rng	
100 mA to 1 A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz	0.41 % + 0.02 % of rng 0.17 % + 0.02 % of rng 0.09 % + 0.02 % of rng 0.11 % + 0.02 % of rng 0.31 % + 0.02 % of rng 1.1 % + 0.04 % of rng	
	(1 to 20) A	0.022 %	Fluke Y5020 w/ HP 3458A
	(20 to 100) A	0.27 %	Empro shunt w/ HP 3458A

Parameter/Range	Frequency	CMC <sup>2,6,11</sup> (±)	Comments
AC Power – Generate <sup>3</sup> (45 to 65) Hz; PF=1 (33 to 330) mV Range			Fluke 5522A
(3.3 to 8.99) mA	110 μW to 3 mW	0.17 %	
(9 to 32.99) mA	(3 to 11) mW	0.12 %	
(33 to 89.99) mA	(1.1 to 30) mW	0.17 %	
(90 to 329.99) mA	(3 to 110) mW	0.12 %	
(0.33 to 0.8999) A	(11 to 300) mW	0.16 %	
(0.9 to 2.1999) A	(30 to 730) mW	0.14 %	
(2.2 to 4.4999) A	73 mW to 1.5 W	0.16 %	
(4.5 to 20.5) A	150 mW to 6.8 W	0.14 %	
330 mV to 1020 V Range			
(3.3 to 8.99) mA	1.1 mW to 9 W	0.15 %	
(9 to 32.99) mA	3 mW to 33 W	0.1 %	
(33 to 89.99) mA	11 mW to 90 W	0.15 %	
(90 to 329.99) mA	30 mW to 330 W	0.1 %	
(0.33 to 0.8999) A	110 mW to 900 W	0.14 %	
(0.9 to 2.1999) A	300 mW to 2200 W	0.11 %	
(2.2 to 4.4999) A	730 mW to 4500 W	0.15 %	
(4.5 to 20.5) A	(1.5 to 20.9) kW	0.12 %	

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Oscilloscopes <sup>3</sup> –			Fluke 5522A w/ SC1100
Square Wave Signal:			
50 Ω Load @ 1 kHz	1 mV to 6.6 V <sub>pk - pk</sub>	0.31 % + 40 μV	
1 MΩ Load @ 1 kHz	1 mV to 130 V <sub>pk - pk</sub>	0.14 % + 40 μV	
DC Volt Amplitude:			
50 Ω Load	(0 to 6.6) V	0.3 % + 40 μV	
1 MΩ Load	(0 to 130) V	0.06 % + 40 μV	

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Oscilloscopes <sup>3</sup> – (cont)			Fluke 5522A w/ SC1100
Level Sine Wave:			
Frequency	(0 to 1100) MHz	3.3 µHz/Hz	
Amplitude	50 kHz Reference 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (300 to 1100) MHz	2.4 % + 300 µV 4.2 % + 300 µV 4.8 % + 300 µV 7.2 % + 300 µV 8.4 % + 300 µV	
Flatness (Bandwidth)	0 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (300 to 1100) MHz	1.8 % + 100 µV 2.4 % + 100 µV 4.8 % + 100 µV 6 % + 100 µV	
Time Markers:			
Into a 50 Ω load	5 s to 50 ms 20 ms to 2 ns	(30 + 1000t) µs/s 3.5 µs/s	
Rise Time:			
1 kHz to 2 MHz (2 to 10) MHz	≤ 300 ps ≤ 350 ps	130 ps 130 ps	
Electrical Simulation of Thermocouples <sup>3</sup> –			Fluke 5522A
Type B	(600 to 800) °C (800 to 1820) °C	0.53 °C 0.43 °C	
Type E	(-250 to -100) °C (-100 to 650) °C (650 to 1000) °C	0.56 °C 0.20 °C 0.26 °C	
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.33 °C 0.20 °C 0.17 °C 0.21 °C 0.28 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.40 °C 0.22 °C 0.20 °C 0.32 °C 0.48 °C	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Simulation of Thermocouples <sup>3</sup> – (cont)			Fluke 5522A
Type N	(-210 to -100) °C (-100 to 410) °C (410 to 1300) °C	0.50 °C 0.30 °C 0.36 °C	
Type R	(0 to 250) °C (250 to 1000) °C (1000 to 1767) °C	0.70 °C 0.42 °C 0.50 °C	
Type S	(0 to 250) °C (250 to 1400) °C (1400 to 1767) °C	0.58 °C 0.46 °C 0.57 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 400) °C	0.76 °C 0.30 °C 0.21 °C	
Electrical Simulation of RTDs <sup>3</sup>			Fluke 5522A
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 (-200 to 100) °C (100 to 800) °C	0.08 °C 0.10 °C 0.11 °C 0.13 °C 0.15 °C 0.28 °C 0.07 °C 0.17 °C	Fluke 754
RTD – Measure <sup>3</sup>			
Pt 385, 100 Ω	(-200 to 100) °C (100 to 800) °C	0.11 °C 0.26 °C	Fluke 754

V. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC <sup>2, 6, 11</sup> (±)	Comments
RF Power – Measure  (-20 to 30) dBm 1 μW to 100 nW	100 kHz to 4.2 GHz	1.5 %	HP437B/8482A

VI. Mechanical

Parameter/Equipment	Range	CMC <sup>2, 6</sup> (±)	Comments
Torque Wrenches <sup>3</sup>	40 in·oz to 600 ft·lbf	0.65 %	CDI suretest 5000-ST
Torque Testers	Up to 1000 ft·lbf	0.08 %	Class F weights w/ torque arms
Rotary Torque Tools <sup>3</sup> – Pneumatic, DC, Pulse	(0.02 to 2) N·m (0.2 to 20) N·m (0.75 to 75) N·m (18 to 180) N·m	1.3 % full scale	Crane-torque star w/ rotary transducers

Parameter/Equipment	Range	CMC <sup>2, 5, 6</sup> (±)	Comments
Force <sup>3</sup> – Tension and Compression (Field Only)	Up to 5000 lbf Up to 10 000 lbf	0.05 % + 0.6R 0.35 % of full scale	Standard weights Load cells w/ indicator
Compression Only (Field Only)	(20 000 to 200 000) lbf	640 lbf	Load cells w/ indicator
Scale and Balances <sup>3</sup>	(1 to 500) mg 500 mg to 5 g (5 to 10) g (10 to 20) g (20 to 50) g (50 to 100) g (100 to 200) g (> 200 to 600) g  (1 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  (1 to 20 000) g (> 20 to 5000) kg  Up to 1000 lbs (1000 to 120 000) lbs	0.006 mg + 0.6R 0.02 mg + 0.6R 0.03 mg + 0.6R 0.045 mg + 0.6R 0.073 mg + 0.6R 0.16 mg + 0.6R 0.3 mg + 0.6R 0.3 mg per 200 g + 0.6R  0.043 mg + 0.6R 0.062 mg + 0.6R 0.096 mg + 0.6R 0.17 mg + 0.6R 0.31 mg + 0.6R 0.63 mg + 0.6R 0.92 mg + 0.6R 1.5 mg + 0.6R 3.1 mg + 0.6R 3.1 mg per 1000 g + 0.6R  0.017 % + 0.6R 0.017 % per 20 000 g + 0.6R  0.017 % + 0.6R 0.017 % per 20 000 lb + 0.6R	ASTM Class 0 weights (applied load)  ASTM Class 1 weights (applied load)  Class F weights (applied load)  Class F weights (applied load)
Piston Operated Volumetric Apparatus <sup>3</sup> – Pipettes and Burettes	(1 to 10) µL (10 to 100) µL (100 to 1000) µL (1000 to 10 000) µL	0.11 µL 0.17 µL 0.63 µL 12 µL	Gravimetric method
Volumetric Measuring Devices –  (Cylinders, Burettes, Pipettes, Syringes, Flasks, Beakers, Vessels)	Up to 80 mL (>80 to 200) mL (>200 to 5000) mL	0.036 mL 0.17 mL 2.2 mL	Gravimetric method

Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
Pressure <sup>3</sup> –  Pneumatic     Hydraulic	(0 to 28) in H <sub>2</sub> O (0 to 200) in H <sub>2</sub> O	0.033 % of full scale 0.03 % of full scale	Merriam M200LS Merriam ZM200LS
	(0.01 to 30) psig	0.07 % of full scale	Fluke 754 / 700PD5 series modules
	(0.01 to 100) psig	0.07 % of full scale	Fluke 754 / 750PD6 series modules
	(0.1 to 300) psig	0.07 % of full scale	Fluke 718 300G
	(0.1 to 300) psig	0.07 % of full scale	Fluke 718 300G
	(0.1 to 1000) psig	0.07 % of full scale	Fluke 754 w/750P08 series modules
	(1 to 10 000) psig  (5 to 10 000) psig	0.12 % of full scale  0.13 %	Fluke 754 w/ 700 series modules  Ametek DM-T-100
Absolute and Barometric Pressure <sup>3</sup>	(0 to 60) in Hg	0.08 in Hg	Druck DPI705
Atmospheric Pressure (Vacuum <sup>3</sup> )	(0 to 28.5) in Hg	0.07 % of full scale	Fluke 754 w/ 700PD6
Mass – Field Check Weight Comparison <sup>3</sup>  Load Fixtures, Hangers, Package and Check Weights	Up to 70 lbs	0.07 %	Scale w/Class F weights
Indirect Verification of Rockwell Hardness Testers <sup>3</sup>	HRC: Low Medium High  HRB W: Low Medium High	0.56 HRC 0.56 HRC 0.55 HRC  0.54 HRBW 0.42 HRBW 0.42 HRBW	Indirect verification per ASTM E18



Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
Speed/RPM/Rate Simulation	(6 to 200 000) rpm	0.003 %	Agilent 33220A frequency synthesizer
Durometer Calibration – (Type A, B, C, D, DO, O, OO)			ASTM D2240
Indenter Extension and Shape –			
Diameter	Up to 0.105 in	200 μin	Vision system
Radius	Up to 0.125 in	200 μin	
Angle	(25 to 40) °	0.16°	
Extension	Up to 0.105 in	70 μin	Gage blocks
Indenter Display	(0 to 100) duro units	0.7 durometer units	Gage blocks
Spring Calibration – Force	Up to 45 N	0.032 N	Precision bench scale
Speed <sup>3</sup> –			
Optic/Non-Contact:			
RPM Totalizer/Rate Meters	(6 to 200 000) rpm (2 to 3300) fpm	0.018 % 0.018 %	Monarch PLT200
Contact:			
RPM Totalizer/Rate Meters	(6 to 20 000) rpm (2 to 3300) fpm	0.22 % 0.22 %	Monarch PLT200
Totalize Meters <sup>3</sup> – (Length Counters and Totalizers)			
Distance Measure	Up to 2000 yards	0.7 %	Monarch PLT200 w/ encoder wheel

VII. Fluid Quantities

Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
Gas Flow – Air and N2			
Laminar Flow	(0.01 to 10) slpm	0.5 %	Fluke Molbox 1 + <sup>TM</sup> w/Molbloc Elements
Sonic Flow	(10 to 120) slpm	0.8 %	

VIII. Thermodynamics

Parameter/Equipment	Range	CMC <sup>2,10</sup> (±)	Comments
Temperature – Measure	(0 to 100) °C	0.04 °C	Fluke 1524 w/ thermistor probe
	(-200 to 300) °C	0.06 °C	Fluke 1524 w/ PRT probe
	(-200 to 420) °C	0.08 °C	Fluke 1524 w/ PRT probe
Temperature – Measuring Instruments <sup>3</sup>	(-30 to 125) °C	0.087 °C	Fluke 7103 w/ reference probe
	(35 to 350) °C	0.65 °C	Fluke 9140
Plate Temperature – Infrared Devices <sup>3</sup>	Ambient to 100 °C	0.65 °C	Hart scientific 9132
	(100 to 250) °C	0.81 °C	
	(250 to 400) °C	1.1 °C	
Relative Humidity <sup>3</sup>	(10 to 90) % RH	1.5 % RH	Vaisala MI-70 w/ MP77 probe

## VIII. Time and Frequency

Parameter/Equipment	Range	CMC <sup>2,10</sup> ( $\pm$ )	Comments
Frequency – Measuring Equipment <sup>3</sup>	9 kHz to 3.0 GHz 0.01Hz to 2 MHz	2.7 $\mu$ Hz/Hz 5.6 $\mu$ Hz/Hz + 5 $\mu$ Hz	Agilent N9310A Fluke 5522A
Frequency – Measure	(0 to 200) MHz	2.5 $\mu$ Hz/Hz	HP/Agilent 5335A
Timers & Stopwatches <sup>3</sup>	(1 to 3600) s	0.050s	HP 5335A

<sup>1</sup> This laboratory offers commercial calibration and dimensional testing services, and field calibration and field dimensional testing services, where noted.

<sup>2</sup> 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.

<sup>3</sup> 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.

<sup>4</sup> 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.

<sup>5</sup> In the statement of CMC,  $L$  is the numerical value of the nominal length of the device measured in inches;  $R$  is the numerical value of the resolution of the device in its respective units;  $DL$  is the diagonal length of the device in inches.

<sup>6</sup> In the statement of CMC, percentages are to be read as percent of reading unless otherwise noted.

<sup>7</sup> In the statement of CMC,  $t$  represents the time in seconds.

<sup>8</sup> 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.

<sup>9</sup> This test is not equivalent to that of a calibration

<sup>10</sup>Applicable to Optical Comparators ONLY.

<sup>11</sup> 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.

<sup>12</sup>This scope meets A2LA's *P112 Flexible Scope Policy*.



## *Accredited Laboratory*

A2LA has accredited

**J.A. KING**

*Raleigh, NC*

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 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 8<sup>th</sup> day of April 2019.

A blue ink signature of the Vice President of Accreditation Services.

Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 1741.05  
Valid to May 31, 2021

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