



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

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CALIBRATION

Valid To: July 31, 2021

Certificate Number: 1741.04

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory at the location listed above as well as the satellite laboratory location listed below to perform the following calibrations<sup>1,9</sup>:

I. Chemical

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
pH Meters <sup>3</sup> – Fixed Points	4 pH 7 pH 10 pH	0.03 pH 0.04 pH 0.07 pH	Standard pH solutions
Conductivity Meters <sup>3</sup> – Fixed Points	10 µS/cm 100 µS/cm 1000 µS/cm	0.11 µS/cm 0.75 µS/cm 6.5 µS/cm	Standard conductivity solutions

II. Dimensional

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Thickness and Snap Gages <sup>3</sup>	Up to 2 in	$(1.7 + 9.3L) \mu\text{in} + 0.6R$	Master gage blocks
Calipers <sup>3</sup>	Up to 12 in (12 to 24) in (24 to 40) in	$(1.7 + 9.3L) \mu\text{in} + 0.6R$ $(53 + 8L) \mu\text{in} + 0.6R$ $(220 + 6.8L) \mu\text{in} + 0.6R$	Master gage blocks 24 in check master 40 in check master

Parameter/Equipment	Range	CMC <sup>2,4</sup> ( $\pm$ )	Comments
Linear Indicators <sup>3</sup> (Dial and Test)	Up to 2 in	$(1.7 + 9.3L) \mu\text{in} + 0.6R$	Master gage blocks; indicator calibrators
Micrometers <sup>3</sup> – (Inside and Outside)	Up to 12 in (12 to 24) in (24 to 40) in	$(1.7 + 9.3L) \mu\text{in} + 0.6R$ $(53 + 8L) \mu\text{in} + 0.6R$ $(220 + 6.8L) \mu\text{in} + 0.6R$	Master gage blocks 24 in check master 40 in check master
Height Gages <sup>3</sup>	Up to 12 in (12 to 24) in (24 to 40) in	$(1.7 + 9.3L) \mu\text{in} + 0.6R$ $(53 + 8L) \mu\text{in} + 0.6R$ $(220 + 6.8L) \mu\text{in} + 0.6R$	Master gage blocks 24 in check master 40 in check master
Pin Gages <sup>3</sup>	Up to 1 in	80 $\mu\text{in}$	Digimatic micrometer
Feeler Gages <sup>3</sup>	Up to 0.2 in	80 $\mu\text{in}$	Digimatic micrometer
Metal Tape Measures and Steel Rules <sup>3</sup>	(0.1 to 25) ft Up to 12 in	$(5.2 + 69L) \mu\text{in} + 0.6R$ 0.0027 in + 0.6R	Gage blocks Caliper
Angle Indicators and Protractors <sup>3</sup>	30°, 45°, 60°, 75°, 90°	0.05°	Angle block set
Optical Comparators <sup>3</sup> – X-Y Linearity Magnification Angle	Up to 12 in 10× to 250× 0° to 90°	150 $\mu\text{in}$ 0.014 in 0.1°	Glass master and scales Angle block set
Vision systems <sup>3</sup> – X-Y Linearity Z Axis	Up to 18 in Up to 4 in	$(52 + 2.9L) \mu\text{in}$ 60 $\mu\text{in}$	Grid plate Gage blocks

Parameter/Equipment	Range <sup>4</sup>	CMC <sup>2, 4</sup> ( $\pm$ )	Comments
Surface Plates <sup>3</sup> – Grades AA, A, and B –  Repeatability Only  Flatness	---  Up to 60DL in (>60 to 120) DL in	38 $\mu$ m  (31 + 0.2DL) $\mu$ m (30 + 0.3DL) $\mu$ m	Repeat-o-meter  Federal level systems
Surface Finish Specimens – Waviness, Texture and Roughness –  Ra	(2 to 500) $\mu$ m	3.6 $\mu$ m	Surface analyzer
Surface Roughness Meters and Profilometers <sup>3</sup> –  Ra  X Axis Straightness	15.3 $\mu$ m 117.3 $\mu$ m  Up to 150 mm	1.1 $\mu$ m  0.7 $\mu$ m/100 mm	Precision roughness standard  Optical flat
Formtesters <sup>3</sup> –  Gage Head Displacement  Spindle Verification  Axis to Spindle Alignment  Z-Axis Straightness	(0.05 to 2) mm  0.15 $\mu$ m to 2mm  (25 to 250) mm  Up to 150 mm	0.1 $\mu$ m  0.04 $\mu$ m  2.1 $\mu$ m/m  0.7 $\mu$ m/100 mm	Gage blocks  Roundness sphere  Cylindrical square  Optical flat
Contour Systems <sup>3</sup> –  Vertical Displacement  Horizontal Displacement  Radius Compensation  X-Axis Straightness	(2.5 to 60) mm  (5 to 100) mm  (2.56 to 10) mm  Up to 150 mm	0.6 $\mu$ m  1.3 $\mu$ m  1.3 $\mu$ m  0.7 $\mu$ m/100 mm	Gage blocks  Spheres  Pin gages  Optical flat

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

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Surface Finish Measure <sup>7</sup>	(2 to 500) µin	3.6 µin	Surface analyzer
Roundness Measure – Straightness Cylindricity	(350 x 3000) mm Up to 250 mm Up to 100 mm	0.12 µm 0.7 µm/100mm 2.2 µm/m	Formtester
Roundness Calibration – Straightness Cylindricity	(350 x 3000) mm Up to 250 mm Up to 100 mm	0.12 µm 0.7 µm/100 mm 2.2 µm/m	Formtester
Length <sup>7</sup> –  X-Axis Y-Axis Z-Axis  Volumetric	  Up to 39 in (1000 mm) Up to 59 in (1500 mm) Up to 27 in (700 mm)  Up to 70 in (1700 mm)	  (160 + 8.3L) µin (160 + 8.7L) µin (160 + 7.9L) µin  (160 + 8.9L) µin	  Wenzel CMM
Length <sup>7</sup> –  X-Y Measurements  Contact  Laser  Z-Axis	  (18 x 18) in  (18 x 18) in  (18 x 18) in  6 in	  (140 + 8.5L) µin  (150 + 8.4L) µin  (150 + 8.2L) µin  (160 + 12L) µin	  Vision machine

IV. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2, 5, 6</sup> (±)	Comments
DC Voltage <sup>3</sup> – Measure	(0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1000) V	11 $\mu\text{V}/\text{V}$ + 3 $\mu\text{V}$ 10 $\mu\text{V}/\text{V}$ + 0.3 $\mu\text{V}$ 10 $\mu\text{V}/\text{V}$ + 0.05 $\mu\text{V}$ 12 $\mu\text{V}/\text{V}$ + 0.3 $\mu\text{V}$ 27 $\mu\text{V}/\text{V}$ + 0.1 $\mu\text{V}$	Agilent/HP 3458A
	(1 to 6) kV	1.2 %	Fluke 80K-6 and DMM
	(6 to 20) kV (20 to 35) kV (35 to 40) kV	2.4 % 1.2 % 2.4 %	Fluke 80K-40 and DMM
DC Voltage <sup>3</sup> – Generate	(0 to 330) mV (0 to 3.3) V (0 to 33) V (30 to 330) V (100 to 1020) V	25 $\mu\text{V}/\text{V}$ + 1 $\mu\text{V}$ 14 $\mu\text{V}/\text{V}$ + 2 $\mu\text{V}$ 15 $\mu\text{V}/\text{V}$ + 15 $\mu\text{V}$ 22 $\mu\text{V}/\text{V}$ + 150 $\mu\text{V}$ 22 $\mu\text{V}/\text{V}$ + 1.5 mV	Fluke 5522A
DC Power <sup>3</sup> – Generate  33 mV to 1020 V  (0.33 to 329.99) mA (0.33 to 2.9999) A (3 to 20.5) A	  (0.01 to 330) W (0.33 to 3.3) kW (3.3 to 20.5) kW	  0.03 % 0.03 % 0.09 %	  Fluke 5522A
DC Current <sup>3</sup> – Measure	(0 to 100) nA 100 nA to 1 $\mu\text{A}$ (1 to 10) $\mu\text{A}$ (10 to 100) $\mu\text{A}$ 100 $\mu\text{A}$ to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	32 $\mu\text{A}/\text{A}$ + 0.04 nA 23 $\mu\text{A}/\text{A}$ + 0.04 nA 23 $\mu\text{A}/\text{A}$ + 0.1 nA 23 $\mu\text{A}/\text{A}$ + 0.8 nA 23 $\mu\text{A}/\text{A}$ + 5 nA 23 $\mu\text{A}/\text{A}$ + 50 nA 37 $\mu\text{A}/\text{A}$ + 0.5 $\mu\text{A}$ 0.012 % + 10 $\mu\text{A}$	Agilent/HP 3458A
	(1 to 300) A	0.25 %	Empro shunt /DMM

Parameter/Equipment	Range	CMC <sup>2, 5, 6</sup> (±)	Comments
DC Current <sup>3</sup> – Generate	(0 to 330) $\mu$ A (0 to 3.3) mA (0 to 33) mA (0 to 330) mA (0 to 1.1) A (1.1 to 3) A (0 to 11) A (11 to 21) A	0.018 % + 0.02 $\mu$ A 0.012 % + 0.05 $\mu$ A 0.012 % + 0.25 $\mu$ A 0.012 % + 2.5 $\mu$ A 0.024 % + 40 $\mu$ A 0.046 % + 40 $\mu$ A 0.06 % + 500 $\mu$ A 0.12 % + 750 $\mu$ A	Fluke 5522A
	1 mA to 100 A	0.055 % of setting	Valhalla 2555A
DC Clamp-On Meters <sup>3</sup> –			
	Toroidal Non-Toroidal	(Up to 1000) A (Up to 1000) A	0.39 % + 0.5 A 0.65 % + 0.5 A
Resistance <sup>3</sup> – Measure	(0 to 10) $\Omega$ (10 to 100) $\Omega$ 100 $\Omega$ to 1 k $\Omega$ (1 to 10) k $\Omega$ (10 to 100) k $\Omega$ 100 k $\Omega$ to 1 M $\Omega$ (1 to 10) M $\Omega$ (10 to 100) M $\Omega$ 100 M $\Omega$ to 1 G $\Omega$	18 $\mu\Omega/\Omega$ + 50 $\mu\Omega$ 15 $\mu\Omega/\Omega$ + 0.5 m $\Omega$ 14 $\mu\Omega/\Omega$ + 0.5 m $\Omega$ 14 $\mu\Omega/\Omega$ + 5 m $\Omega$ 12 $\mu\Omega/\Omega$ + 50 m $\Omega$ 17 $\mu\Omega/\Omega$ + 2 $\Omega$ 52 $\mu\Omega/\Omega$ + 100 $\Omega$ 0.05 % + 1 k $\Omega$ 0.5 % + 10 k $\Omega$	Agilent/HP 3458A
Resistance <sup>3</sup> – Generate	(0 to 11) $\Omega$ (11 to 33) $\Omega$ (33 to 110) $\Omega$ 110 $\Omega$ to 1.1 k $\Omega$ (1.1 to 11) k $\Omega$ (11 to 110) k $\Omega$ 110 k $\Omega$ to 1.1 M $\Omega$ (1.1 to 3.3) M $\Omega$ (3.3 to 11) M $\Omega$ (11 to 33) M $\Omega$ (33 to 110) M $\Omega$ (110 to 330) M $\Omega$ (330 to 1100) M $\Omega$	49 $\mu\Omega/\Omega$ + 0.001 $\Omega$ 37 $\mu\Omega/\Omega$ + 0.0015 $\Omega$ 34 $\mu\Omega/\Omega$ + 0.0014 $\Omega$ 34 $\mu\Omega/\Omega$ + 0.002 $\Omega$ 34 $\mu\Omega/\Omega$ + 0.02 $\Omega$ 34 $\mu\Omega/\Omega$ + 0.2 $\Omega$ 39 $\mu\Omega/\Omega$ + 2 $\Omega$ 73 $\mu\Omega/\Omega$ + 30 $\Omega$ 0.016 % + 50 $\Omega$ 0.03 % + 2.5 k $\Omega$ 0.06 % + 3 k $\Omega$ 0.36 % + 100 k $\Omega$ 1.8 % + 500 k $\Omega$	Fluke 5522A
	Fixed Points <sup>3</sup>	10 M $\Omega$ 100 M $\Omega$ 1 G $\Omega$ 10 G $\Omega$ 100 G $\Omega$	1.2 % 1.2 % 1.2 % 1.2 % 1.2 %

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> (±)	Comments
Capacitance <sup>3</sup> – Generate			
40 pF to 1.2 μF	--	0.5 % + 3 pF	Agilent/HP 4440B
(220.0 to 399.9) pF	(10 to 10 000) Hz	0.6 % + 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	0.3 % + 0.1 nF	
(11 to 109.999) nF	(10 to 1000) Hz	0.3 % + 0.1 nF	
(110 to 329.999) nF	(10 to 1000) Hz	0.3 % + 0.3 nF	
(0.33 to 1.099 99) μF	(10 to 600) Hz	0.3 % + 1 nF	
(1.1 to 3.299 99) μF	(10 to 300) Hz	0.3 % + 3 nF	
(3.3 to 10.9999) μF	(10 to 150) Hz	0.3 % + 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	0.54 % + 300 nF	
(.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	
AC Voltage <sup>3</sup> – Generate			
(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	0.096 % + 6 μV 0.019 % + 6 μV 0.025 % + 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	
(0.33 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 0.019 % + 60 μV 0.023 % + 60 μV 0.036 % + 50 μV 0.084 % + 130 μV 0.29 % + 600 μV	

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> (±)	Comments
AC Voltage <sup>3</sup> – Generate (cont)			
(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 0.019 % + 600 μV 0.029 % + 600 μV 0.042 % + 600 μV 0.11 % + 1.6 mV	Fluke 5522A
(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 0.025 % + 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	
AC Voltage <sup>3</sup> – Measure			
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	0.03 % + 0.03 % of rng 0.02 % + 0.01 % of rng 0.03 % + 0.01 % of rng 0.1 % + 0.01 % of rng 0.5 % + 0.01 % of rng 4 % + 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 0.014 % + 0.002 % of rng 0.03 % + 0.002 % of rng 0.08 % + 0.002 % of rng 0.3 % + 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	0.02 % + 0.004 % of rng 0.02 % + 0.002 % of rng 0.02 % + 0.002 % of rng 0.035 % + 0.002 % of rng 0.12 % + 0.002 % of rng 0.4 % + 0.01 % of rng	
(100 to 700) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.041 % + 0.004 % of rng 0.041 % + 0.002 % of rng 0.061 % + 0.002 % of rng 0.013 % + 0.002 % of rng 0.31 % + 0.002 % of rng	
700 V to 6 kV	(1 to 500) Hz	1.2 %	Fluke 80K-6 and DMM
(6 to 40) kV	(1 to 500) Hz	6 %	Fluke 80K-40 and DMM



Parameter/Range	Frequency	CMC <sup>2, 5</sup> (±)	Comments
AC Current <sup>3</sup> – Generate			
(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 2 % + 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	0.25 % + 0.15 µA 0.16 % + 0.15 µA 0.13 % + 0.15 µA 0.25 % + 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 0.096 % + 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) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.22 % + 100 µA 0.072 % + 100 µA 0.72 % + 1 mA 3 % + 5 mA	
(3 to 11) A	45 Hz to 1 kHz (1 to 5) kHz	0.12 % + 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	
1 mA to 100 A	100 Hz 400 Hz 1 kHz	0.23 % of setting 0.35 % of setting 0.52 % of setting	Valhalla 2555A

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> (±)	Comments
AC Clamp-On Meters <sup>3</sup> – (Up to 150) A			
Toroidal	(45 to 65) Hz (65 to 440) Hz	0.49 % + 0.025 A 1 % + 0.027 A	Fluke 5522A w/ 5500 coil
Non-Toroidal	(45 to 65) Hz (65 to 440) Hz	0.76 % + 0.25 A 1.3 % + 0.25 A	
(150 to 1025) A			
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 Hz to 1 kHz 100 Hz to 5 kHz	0.4 % + 0.03 % of rng 0.15 % + 0.03 % of rng 0.06 % + 0.03 % of rng 0.06 % + 0.03 % of rng	Agilent/HP 3458A
(0.1 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	0.4 % + 0.02 % of rng 0.15 % + 0.02 % of rng 0.06 % + 0.02 % of rng 0.03 % + 0.02 % of rng 0.06 % + 0.02 % of rng 0.4 % + 0.04 % of rng 0.55 % + 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	0.4 % + 0.02 % of rng 0.16 % + 0.02 % of rng 0.08 % + 0.02 % of rng 0.1 % + 0.02 % of rng 0.3 % + 0.02 % of rng 1 % + 0.04 % of rng	

Parameter/Range	Frequency	CMC <sup>2,5,6</sup> (±)	Comments
AC Power – Generate <sup>3</sup> (45 to 65) Hz; PF=1 (33 to 330) mV Range (3.3 to 8.99) mA (9 to 32.99) mA (33 to 89.99) mA (90 to 329.99) mA (0.33 to 0.8999) A (0.9 to 2.1999) A (2.2 to 4.4999) A (4.5 to 20.5) A 330 mV to 1020 V Range (3.3 to 8.99) mA (9 to 32.99) mA (33 to 89.99) mA (90 to 329.99) mA (0.33 to 0.8999) A (0.9 to 2.1999) A (2.2 to 4.4999) A (4.5 to 20.5) A	110 μW to 3 mW (3 to 11) mW (1.1 to 30) mW (3 to 110) mW (11 to 300) mW (30 to 730) mW 73 mW to 1.5 W 150 mW to 6.8 W 1.1 mW to 9 W 3 mW to 33 W 11 mW to 90 W 30 mW to 330 W 110 mW to 900 W 300 mW to 2200 W 730 mW to 4500 W (1.5 to 20.9) kW	0.17 % 0.12 % 0.17 % 0.12 % 0.16 % 0.14 % 0.16 % 0.14 % 0.15 % 0.1 % 0.15 % 0.1 % 0.1 % 0.14 % 0.11 % 0.15 % 0.12 %	Fluke 5522A
Oscilloscopes <sup>3</sup> – Square Wave Signal: 50 Ω Load @ 1 kHz 1 MΩ Load @ 1 kHz DC Volt Amplitude: 50 Ω Load 1 MΩ Load	1 mV to 6.6 V <sub>pk-pk</sub> 1 mV to 130 V <sub>pk-pk</sub> (0 to 6.6) V (0 to 130) V (0 to 330) mV (0 to 3.3) V (0 to 33) V (30 to 330) V (100 to 1020) V	0.31 % + 40 μV 0.14 % + 40 μV 0.3 % + 40 μV 0.06 % + 40 μV 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 w/ SC1100            Fluke 5522A

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> ( $\pm$ )	Comments
Oscilloscopes <sup>3</sup> – (cont)			
Level Sine Wave:			
Frequency	(0 to 1100) MHz	3.3 $\mu$ Hz/Hz	Fluke 5522A
Amplitude			
50 kHz Reference	5 mV to 5.5 V	2.4 % + 300 $\mu$ V	
50 kHz to 100 MHz	5 mV to 5.5 V	4.2 % + 300 $\mu$ V	
(100 to 300) MHz	5 mV to 5.5 V	4.8 % + 300 $\mu$ V	
(300 to 600) MHz	5 mV to 5.5 V	7.2 % + 300 $\mu$ V	
(600 to 1100) MHz	4 mV to 3.5 V	8.4 % + 300 $\mu$ V	
Flatness (Bandwidth)			
0 kHz to 100 MHz	5 mV to 5.5 V	1.8 % + 100 $\mu$ V	
(100 to 300) MHz	5 mV to 5.5 V	2.4 % + 100 $\mu$ V	
(300 to 600) MHz	5 mV to 5.5 V	4.8 % + 100 $\mu$ V	
(600 to 1100) MHz	4 mV to 3.5 V	6 % + 100 $\mu$ V	
Time Markers: Into a 50 $\Omega$ Load			$t$ = time in seconds
	5 s to 50 ms 20 ms to 1 ns	(30 + 1000 $t$ ) $\mu$ s/s 3.5 $\mu$ s/s	
Rise Time:			
1 kHz to 2 MHz	$\leq$ 300 ps	130 ps	
(2 to 10) MHz	$\leq$ 350 ps	130 ps	
Electrical Simulation of RTDs <sup>3</sup>			
Pt 385, 100 $\Omega$	(-200 to 0) $^{\circ}$ C (0 to 100) $^{\circ}$ C (100 to 300) $^{\circ}$ C (300 to 400) $^{\circ}$ C (400 to 630) $^{\circ}$ C (630 to 800) $^{\circ}$ C	0.08 $^{\circ}$ C 0.10 $^{\circ}$ C 0.11 $^{\circ}$ C 0.13 $^{\circ}$ C 0.15 $^{\circ}$ C 0.28 $^{\circ}$ C	Fluke 5522A

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Thermocouple Simulation <sup>3</sup> –			
Type B	(600 to 800) °C (800 to 1820) °C	0.54 °C 0.42 °C	Fluke 5522A
Type E	(-250 to -100) °C (-100 to 650) °C (650 to 1000) °C	0.61 °C 0.22 °C 0.28 °C	
Type J	(-210 to -100) °C (-100 to 760) °C (760 to 1200) °C	0.34 °C 0.23 °C 0.30 °C	
Type K	(-200 to -100) °C (-100 to 1000) °C (1000 to 1372) °C	0.41 °C 0.33 °C 0.49 °C	
Type N	(-200 to -100) °C (-100 to 410) °C (410 to 1300) °C	0.49 °C 0.29 °C 0.34 °C	
Type R	(0 to 250) °C (250 to 1000) °C (1000 to 1767) °C	0.70 °C 0.41 °C 0.49 °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 0.31 °C 0.22 °C	

V. Mechanical

Parameter/Equipment	Range	CMC <sup>2, 4, 6</sup> ( $\pm$ )	Comments
Scales and Balances <sup>3</sup>	(1 to 5) g	0.041 mg + 0.6R	ASTM Class 1 weights (applied load)
	Up to 10 g	0.06 mg + 0.6R	
	Up to 30 g	0.09 mg + 0.6R	
Up to 50 g	0.14 mg + 0.6R		
Up to 100 g	0.3 mg + 0.6R		
Up to 200 g	0.6 mg + 0.6R		
Up to 300 g	0.9 mg + 0.6R		
Up to 500 g	1.5 mg + 0.6R		
Up to 1000 g	3 mg + 0.6R		
	1 g to 20 kg (20 to 900) kg	0.017 % + 0.6R 0.017 % per 20 kg + 0.6R	
	Up to 1000 lb (1000 to 16 000) lb	0.017 % + 0.6R 0.017 % per 1000 lb + 0.6R	
Force Gages <sup>3</sup>	1 g to 20 kgf (20 to 900) kgf Up to 500 lbf	0.017 % + 0.6R 0.017 % per 20 kgf + 0.6R 0.017 % + 0.6R	Class F weights (applied load)
Torque Wrenches <sup>3</sup>	4 in·lbf to 600 ft·lbf	0.65 %	CDI suretest 5000-ST
Torque Testers <sup>3</sup>	4 in·lbf to 600 ft·lbf	0.065 %	Class F weights and torque arms
Speed/RPM/Rate <sup>3</sup> – Simulation	(2.5 to 100 000) RPM	0.004 %	Agilent 33250A
Speed/RPM/Rate <sup>3</sup> – Non-Contact	(6 to 60 000) RPM	0.02 %	Monarch tachometer
Totalize Meters <sup>3</sup> – (Length Counters and Totalizers)			
Distance – Measure	Up to 500 yards	0.51 %	Shimpo tach w/ encoder wheel

Parameter/Equipment	Range	CMC <sup>2, 4, 6</sup> (±)	Comments	
Pressure <sup>3</sup> – Measuring Equipment	Differential	(0.25 to 0.5) inH <sub>2</sub> O	0.000 24 inH <sub>2</sub> O	Heise HM2
		(0.25 to 0.5) inH <sub>2</sub> O	0.000 59 inH <sub>2</sub> O	
		(0.5 to 1) inH <sub>2</sub> O	0.000 95 inH <sub>2</sub> O	
		(1 to 10) inH <sub>2</sub> O	0.0075 inH <sub>2</sub> O	
	Absolute	Up to 16 psia	Greater of 0.015 % or 0.006 % FS	Fluke 6270 w/PM500 modules
	Pneumatic	Up to 15 psi	Greater of 0.015 % or 0.006 % FS	
		(-15 to 300) psi	Greater of 0.015 % or 0.006 % FS	
		(300 to 1000) psi	Greater of 0.015 % or 0.006 % FS	
	Hydraulic	(1000 to 3000) psi	Greater of 0.015 % or 0.006 % FS	Ruska 2465-753
		(0.2 to 1000) psi	0.0084 %	
		(5 to 20 000) psi	0.021 %	Fluke 3116
Barometric Pressure <sup>3</sup> – Measuring Equipment	(17 to 34) inHg	0.02 %	Mensor CPG2300	
Vacuum <sup>3</sup>	(0 to 30) inHg	0.04 % Full Scale	Mensor DPG 210	

VI. Thermodynamics

Parameter/Equipment	Range	CMC <sup>2, 8</sup> (±)	Comments
Humidity <sup>3</sup> – Measure	(10 to 90) % RH	1.6 % RH	Vaisala HMP-233
Humidity <sup>3</sup> – Measuring Devices	(10 to 90) % RH	1.6 % RH	Vaisala HMP-233
Temperature <sup>3</sup> – Measuring Devices	(-15 to 110) °C (50 to 350) °C	0.3 °C 0.75 °C	Fluke 9009
Temperature <sup>3</sup> – Measure	(0 to 100) °C  (-200 to 300) °C  (300 to 450) °C	0.04 °C  0.06 °C  0.37 °C	Fluke 1524 w/ thermistor probe  Fluke 1524 w/ PRT probe  ASL F250 w/ matching RTD system
Infrared Measuring Devices <sup>3</sup>	(-15 to 0) °C (0 to 120) °C  35 °C (35 to 100) °C (100 to 200) °C (200 to 350) °C (350 to 500) °C	0.61 °C 0.73 °C  0.84 °C 0.95 °C 1.2 °C 1.7 °C 2.3 °C	Fluke 4180  Fluke 4181

VII. Time and Frequency

Parameter/Equipment	Range	CMC <sup>2, 8</sup> (±)	Comments
Frequency – Measuring Equipment <sup>3</sup>	(0 to 1100) MHz	3.3 µHz/Hz	Fluke 5522A/1 GHz
Frequency – Measure <sup>3</sup>	Up to 225 MHz	0.23 µHz/Hz	HP 53131A
Timers and Stop Watches <sup>3</sup>	(2 to 3600) s	0.1 s	HP 53131A w/ Agilent 33250A



CALIBRATION

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations<sup>1,9</sup>:

I. Dimensional

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Cylindrical Measure –  Plain Rings	Up to 14 in	(6.9 + 1.8L) μin	P and W Labmaster™
Pins, Plain Plugs, Discs, Spheres – External Diameter	Up to 13 in	(6.9 + 1.8L) μin	
Gage Blocks, Jo Blocks, Length Gages, Fixture Gages	Up to 12 in	(6.9 + 1.5L) μin	P and W Labmaster™
Hand Tools – Depth Gages, Snap Gages, Fixture Gages, Thickness Gages	Up to 12 in (12 to 40) in	(4.6 + 2.8L) μin + 0.6R (13 + 2.1L) μin + 0.6R	Gage blocks
Height Gages	Up to 48 in	(56 + 1.3L) μin	Gage blocks
Calipers	Up to 12 in (12 to 24) in (24 to 40) in	(1.7 + 9.3L) μin + 0.6R (53 + 8L) μin + 0.6R (220 + 6.8L) μin + 0.6R	Master gage blocks 24 in check master 40 in check master
Linear Indicators, Dial and Test	(0.5 to 4) in  Up to 12 in	(4.3 + 3.3L) μin + 0.6R  (6.9 + 1.5L) μin + 0.6R	Gage blocks  P and W Labmaster™

Parameter/Equipment	Range	CMC <sup>2, 4</sup> ( $\pm$ )	Comments
Micrometers – Outside Inside	Up to 12 in (12 to 40) in	(4.6 + 2.8L) $\mu$ in + 0.6R (13 + 2.1L) $\mu$ in + 0.6R	Gage blocks
Thread Plugs – Major Diameter Pitch Diameter	Up to 7 in Up to 7 in	(6.9 + 1.8L) $\mu$ in (98 + 0.2L) $\mu$ in	P and W Labmaster™ w/ thread wires
NPT Plugs – Simple Pitch Diameter	Up to 7 in	(100 + 0.2L) $\mu$ in	P and W Labmaster™ w/ thread wires and taper master
Spline Gages – Plugs Diameter (Over Pins) Rings Diameter (Over Pins)	Up to 7 in Up to 7 in	(46 + 0.2L) $\mu$ in (46 + 0.2L) $\mu$ in	P and W Labmaster™ w/ gear wires

<sup>1</sup> This laboratory offers commercial and field calibration/dimensional testing services and is performed at the main laboratory and satellite laboratory listed.

<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> In the statement of CMC,  $L$  is the numerical value of the nominal length of the device measured in inches, and  $R$  is the numerical value of the resolution of the device in microinches and in the statement of the Range,  $DL$  is the diagonal length of the device in inches.
- <sup>5</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. CMCs are expressed as either a specific value that covers the full range or as a fraction/percentage of the reading plus a fixed floor specification.
- <sup>6</sup> In the statement of CMC a percentage refers to percent of reading unless otherwise noted.
- <sup>7</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>8</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>9</sup> This scope meets A2LA's *P112 Flexible Scope Policy*.



# Accredited Laboratory

A2LA has accredited

**CROSS TECHNOLOGIES, INC DBA CROSS (FORMERLY J.A. KING)**

*Greenville, SC*

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 17<sup>th</sup> day of September 2019.

A blue ink signature of the Vice President of Accreditation Services, written over a horizontal line.

Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 1741.04  
Revised December 31, 2019  
Valid to July 31, 2021  
Revised May 13, 2021

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