



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

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CALIBRATION

Valid To: October 31, 2019

Certificate Number: 1489.01

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

I. Dimensional

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Angle Blocks	Up to 90°	0.02°	Optical comparator
Calipers <sup>3</sup>	Up to 24 in ( < 24 to 60) in	(300 + 10L) μin (1400 + 1.2L) μin	Gage blocks
Cylindrical Plugs/Pins	Up to 1 in	(13 + 8D) μin	P&W Labmaster™, gage block masters
	Up to 1 in	46 μin	Mitutoyo laser micrometer, gage block masters
Cylindrical Ring Gages	(0.25 to 12) in	(18 + 7D) μin	P&W Labmaster™, master rings
Dial Indicators <sup>3</sup>	Up to 4 in	(76 + 91L) μin	Gage blocks
Feeler Gages	Up to 0.05 in	(18 + 7L) μin	P&W Labmaster™, gage block masters

Parameter/Equipment	Range	CMC <sup>2,4</sup> ( $\pm$ )	Comments
Gage Balls	(0.125 to 1) in	$(20 + 7D) \mu\text{in}$	P&W Labmaster <sup>TM</sup> , gage block masters
Gage Blocks	(0.005 to 12) in	$(12 + 8L) \mu\text{in}$	P&W Labmaster <sup>TM</sup> , gage block masters
Height Gages <sup>3</sup>	Up to 40 in	$(600 + 41L) \mu\text{in}$	Gage blocks
Snap Gages	(0.25 to 14) in	$(18 + 7L) \mu\text{in}$	P&W Labmaster <sup>TM</sup> , master rings
	(14 to 24) in	$(55 + 8L) \mu\text{in}$	Gage blocks
Bore Gage	Up to 2 in	58 $\mu\text{in}$	Master rings
Micrometers <sup>3</sup> – Outside	Up to 6 in ( $< 6$ to 60) in	$(55 + 8L) \mu\text{in}$ $(530 + 5L) \mu\text{in}$	Gage blocks
Optical Comparator <sup>3</sup> –			
Axis Linearity	12 in	$(260 + 0.5L) \mu\text{in}$	Glass master scales, angle blocks
Magnification	(10, 20, 50, 100, 125, 250) x	$(620 + 0.5L) \mu\text{in}$	
Angle	Up to 360°	0.3°	
Rules <sup>3</sup>	Up to 72 in	0.6R	Gage blocks
Thread Plugs –			P&W Labmaster <sup>TM</sup> , gage block masters, thread wire masters
Pitch Diameter	Up to 4 in	$(88 + 6D) \mu\text{in}$	
Major Diameter	Up to 4 in	$(13 + 8D) \mu\text{in}$	
Thread Wires	Up to 0.500 in diameter	$(31 + 6D) \mu\text{in}$	P&W Labmaster <sup>TM</sup> , gage block masters, plug gage masters

Parameter/Equipment	Range	CMC <sup>2,4</sup> ( $\pm$ )	Comments
Protractors	Up to 360°	0.08°	Sine plate and gage blocks
Surface Plates <sup>3</sup> – Flatness	Up to 144 in	(72 + 0.3L) $\mu$ in	Planekator,
Repeatability	Up to 144 in	49 $\mu$ in	Repeat-O-Meter

## II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2,4,6</sup> ( $\pm$ )	Comments
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 1000) V	20 $\mu$ V/V + 1 $\mu$ V 11 $\mu$ V/V + 2 $\mu$ V 12 $\mu$ V/V + 20 $\mu$ V 18 $\mu$ V/V + 150 $\mu$ V 18 $\mu$ V/V + 1.5 mV	Fluke 5522A
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	14 $\mu$ V/V + 3 $\mu$ V 7 $\mu$ V/V + 0.3 $\mu$ V 6 $\mu$ V/V + 0.05 $\mu$ V 10 $\mu$ V/V + 0.3 $\mu$ V 9 $\mu$ V/V + 0.1 $\mu$ V	Hewlett Packard 3458A opt 002
DC Current – Measure <sup>3</sup>	(0 to 100) nA 100 nA to 1 $\mu$ A (1 to 10) $\mu$ A (10 to 100) $\mu$ A 100 $\mu$ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A  (1 to 100) A (100 to 500) A (500 to 1000) A (1000 to 1500) A	58 $\mu$ A/A + 400 $\mu$ A 89 $\mu$ A/A + 40 $\mu$ A 66 $\mu$ A/A + 10 $\mu$ A 29 $\mu$ A/A + 8 $\mu$ A 25 $\mu$ A/A + 5 $\mu$ A 25 $\mu$ A/A + 5 $\mu$ A 40 $\mu$ A/A + 5 $\mu$ A 120 $\mu$ A/A + 10 $\mu$ A  0.29 % 1.4 % 2.9 % 4.3 %	Hewlett Packard 3458A opt 002  Empro Shunt w/ Agilent 3458A

Parameter/Equipment	Range	CMC <sup>2, 6</sup> ( $\pm$ )	Comments
DC Current – Generate <sup>3</sup>	(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 20.5) A	0.26 % + 0.02 $\mu$ A 0.029 % + 0.05 $\mu$ A 0.011 % + 0.25 $\mu$ A 0.024 % + 2.5 $\mu$ A 0.024 % + 40 $\mu$ A 0.039 % + 40 $\mu$ A 0.055 % + 500 $\mu$ A 0.10 % + 750 $\mu$ A	Fluke 5522A
Resistance – Generate <sup>3</sup>	(0 to 11) $\Omega$ (11 to 33) $\Omega$ (33 to 110) $\Omega$ (110 to 330) $\Omega$ (0.33 to 1.1) k $\Omega$ (1.1 to 3.3) k $\Omega$ (3.3 to 11) k $\Omega$ (11 to 33) k $\Omega$ (33 to 110) k $\Omega$ (110 to 330) k $\Omega$ (0.33 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 $\Omega$ (0.33 to 1.1) G $\Omega$	41 $\mu\Omega/\Omega$ + 0.001 $\Omega$ 30 $\mu\Omega/\Omega$ + 0.0015 $\Omega$ 29 $\mu\Omega/\Omega$ + 0.0014 $\Omega$ 28 $\mu\Omega/\Omega$ + 0.002 $\Omega$ 28 $\mu\Omega/\Omega$ + 0.002 $\Omega$ 28 $\mu\Omega/\Omega$ + 0.02 $\Omega$ 28 $\mu\Omega/\Omega$ + 0.02 $\Omega$ 28 $\mu\Omega/\Omega$ + 0.2 $\Omega$ 28 $\mu\Omega/\Omega$ + 0.2 $\Omega$ 32 $\mu\Omega/\Omega$ + 2 $\Omega$ 33 $\mu\Omega/\Omega$ + 2 $\Omega$ 60 $\mu\Omega/\Omega$ + 30 $\Omega$ 0.013 % + 50 $\Omega$ 0.025 % + 2.5 k $\Omega$ 0.051 % + 3 k $\Omega$ 0.30 % + 100 k $\Omega$ 1.5 % + 500 k $\Omega$	Fluke 5522A
Resistance – Measure <sup>3</sup>	(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 $\Omega$	22 $\mu\Omega/\Omega$ + 50 $\mu\Omega$ 18 $\mu\Omega/\Omega$ + 0.5 $\mu\Omega$ 11 $\mu\Omega/\Omega$ + 0.5 m $\Omega$ 11 $\mu\Omega/\Omega$ + 5 m $\Omega$ 11 $\mu\Omega/\Omega$ + 50 m $\Omega$ 19 $\mu\Omega/\Omega$ + 2 $\Omega$ 61 $\mu\Omega/\Omega$ + 100 $\Omega$ 0.052 % + 1 k $\Omega$ 0.52 % + 10 k $\Omega$	Hewlett Packard 3458A opt 002

Parameter/Range	Frequency	CMC <sup>2, 6</sup> (±)	Comments
Capacitance – Generate <sup>3</sup>  (220 to 399.9) pF (0.4 to 1.0999) nF (1.1 to 3.2999) nF (3.3 to 10.9999) nF (11 to 32.9999) nF (33 to 109.999) nF (110 to 329.999) nF (0.33 to 1.099 99) μF (1.1 to 3.299 99) μF (3.3 to 10.9999) μF (11 to 32.9999) μF (33 to 109.999) μF (110 to 329.999) μF (0.33 to 1.099 99) mF (1.1 to 3.299 99) mF (3.3 to 10.9999) mF (11 to 32.9999) mF (33 to 110) mF	(10 to 10 000) Hz (10 to 10 000) Hz (10 to 3000) Hz (10 to 1000) Hz (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 (0 to 50) Hz (0 to 20) Hz (0 to 6) Hz (0 to 2) Hz (0 to 0.6) Hz (0 to 0.2) Hz	0.41 % + 10 pF 0.39 % + 0.01 nF 0.39 % + 0.01 nF 0.20 % + 0.01 nF 0.19 % + 0.01 nF 0.19 % + 0.01 nF 0.19 % + 0.03 nF 0.56 % + 1 nF 0.26 % + 3 nF 0.20 % + 10 nF 0.31 % + 30 nF 0.35 % + 100 nF 0.35 % + 300 nF 0.35 % + 1 μF 0.35 % + 3 μF 0.35 % + 10 μF 0.60 % + 30 μF 0.43 % + 100 μF	Fluke 5522A
AC Voltage – Generate <sup>3</sup>  (1 to 33) mV   (33 to 330) mV   (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  (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  (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	0.10 % + 6 μV 0.042 % + 6 μV 0.046 % + 6 μV 0.12 % + 6 μV 0.39 % + 12 μV 0.95 % + 50 μV  0.042 % + 8 μV 0.032 % + 8 μV 0.033 % + 8 μV 0.046 % + 8 μV 0.094 % + 32 μV 0.22 % + 70 μV  0.041 % + 50 μV 0.031 % + 60 μV 0.034 % + 60 μV 0.041 % + 50 μV 0.078 % + 130 μV 0.26 % + 600 μV	Fluke 5522A



Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> ( $\pm$ )	Comments
AC Voltage – Generate <sup>3</sup> (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	0.24 % + 650 $\mu$ V 0.031 % + 600 $\mu$ V 0.037 % + 600 $\mu$ V 0.045 % + 600 $\mu$ V 0.098 % + 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	0.020 % + 2 mV 0.022 % + 6 mV 0.027 % + 6 mV 0.032 % + 6 mV 0.22 % + 50 mV	
(330 to 1020) V	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.031 % + 10 mV 0.026 % + 10 mV 0.031 % + 10 mV	
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	0.030 % + 0.03 % 0.020 % + 0.011 % 0.030 % + 0.011 % 0.10 % + 0.011 % 0.50 % + 0.011 % 4.0 % + 0.02 %	Hewlett Packard 3458A opt 002
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 300 kHz to 1 MHz (1 to 2) MHz	0.007 % + 0.004 % 0.007 % + 0.002 % 0.014 % + 0.002 % 0.030 % + 0.002 % 0.080 % + 0.002 % 0.30 % + 0.03 % 1.0 % + 0.01 % 1.5 % + 0.01 %	
(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 300 kHz to 1 MHz	0.020 % + 0.004 % 0.020 % + 0.002 % 0.020 % + 0.002 % 0.035 % + 0.002 % 0.12 % + 0.002 % 0.40 % + 0.01 % 1.5 % + 0.01 %	

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> (±)	Comments
AC Voltage – Measure <sup>3</sup> (cont)  (100 to 1000) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.040 % + 0.004 % 0.040 % + 0.002 % 0.060 % + 0.002 % 0.12 % + 0.002 % 0.30 % + 0.002 %	Hewlett Packard 3458A opt 002
AC Current – Generate <sup>3</sup>  (29 to 330) µA	(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	0.23 % + 0.1 µA 0.32 % + 0.1 µA 0.16 % + 0.1 µA 0.35 % + 0.15 µA 0.86 % + 0.2 µA 1.7 % + 50 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	0.21 % + 0.15 µA 0.13 % + 0.15 µA 0.11 % + 0.1 µA 0.21 % + 0.2 µA 0.51 % + 0.3 µA 1.0 % + 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	0.19 % + 2 µA 0.10 % + 2 µA 0.053 % + 2 µA 0.090 % + 2 µA 0.21 % + 3 µA 0.41 % + 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	0.19 % + 20 µA 0.10 % + 20 µA 0.053 % + 20 µA 0.12 % + 50 µA 0.23 % + 100 µA 0.46 % + 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	0.21 % + 100 µA 0.098 % + 100 µA 0.70 % + 1 mA 3.0 % + 5 mA	
(1.1 to 3) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.19 % + 100 µA 0.070 % + 100 µA 0.63 % + 1 mA 2.7 % + 5 mA	

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> (±)	Comments
AC Current – Generate <sup>3</sup> (cont)			
(3 to 11) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.080 % + 2 mA 0.12 % + 2 mA 3.0 % + 2 mA	Fluke 5522A
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.15 % + 5 mA 0.18 % + 5 mA 3.0 % + 5 mA	
Clamp-On Only			
(20.5 to 150) A (150 to 1000) A	(45 to 65) Hz (45 to 65) Hz	0.42 % 0.44 %	Fluke 5522A w/ 5500A/Coil
(20.5 to 150) A (150 to 1000) A	(65 to 440) Hz (65 to 440) Hz	1.2 % 1.2 %	
AC Current – Measure <sup>3</sup>			
(0 to 100) µA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 100 Hz 100 Hz to 5 kHz	0.40 % + 0.03 % 0.15 % + 0.03 % 0.060 % + 0.03 % 0.060 % + 0.03 %	Hewlett Packard 3458A opt 002
(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	0.40 % + 0.02 % 0.15 % + 0.03 % 0.060 % + 0.02 % 0.030 % + 0.02 % 0.060 % + 0.02 % 0.40 % + 0.04 % 0.55 % + 0.15%	
(0.1 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	0.40 % + 0.02 % 0.16 % + 0.02 % 0.080 % + 0.02 % 0.10 % + 0.02 % 0.30 % + 0.02 % 1.0 % + 0.04 %	



Parameter/Range	Frequency	CMC <sup>2,6</sup> (±)	Comments
Oscilloscopes <sup>3</sup> –			
Square Wave Signal: (1 kHz Input)			
50 Ω Load @ 1 kHz	1 mV to 6.6 V <sub>pk-pk</sub>	0.19 % + 40 μV	Fluke 5522A SC1100
1 MΩ Load @ 1 kHz	1 mV to 130 V <sub>pk-pk</sub>	0.08 % + 40 μV	
DC Volt Amplitude:			
50 Ω Load	(0 to 6.6) V	0.19 % + 40 μV	
1 MΩ Load	(0 to 130) V	0.04 % + 40 μV	
Leveled Sine Wave: Frequency	(0 to 1100) MHz	2.3 μHz/Hz	
Leveled Sine Wave Amplitude	50 kHz (Reference)	1.6 % + 300 μV	
	50 kHz to 100 MHz	2.7 % + 300 μV	
	(100 to 300) MHz	3.1 % + 300 μV	
	(300 to 600) MHz	4.7 % + 300 μV	
	(600 to 1100) MHz	5.4 % + 300 μV	
Flatness (Bandwidth)	50 kHz to 100 MHz	1.2 % + 100 μV	
	(100 to 300) MHz	1.6 % + 100 μV	
	(300 to 600) MHz	3.1 % + 100 μV	
	(600 to 1100) MHz	3.9 % + 100 μV	
Time Marker	5 s to 50 ms	(19 + 1000t) μs/s	t = time in seconds
	20 ms to 1 ns	1.4 μs/s	
Rise Time	≥ 300 ps	79 ps	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Calibration of RTD Indicators <sup>3</sup> –			
Pt 385, 100 Ω	(-200 to -80) °C	0.06 °C	Fluke 5522A
	(-80 to 0) °C	0.06 °C	
	(0 to 100) °C	0.09 °C	
	(100 to 300) °C	0.1 °C	
	(300 to 400) °C	0.1 °C	
	(400 to 630) °C	0.2 °C	
	(630 to 800) °C	0.3 °C	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Calibration of RTD Indicators <sup>3</sup> – (cont)			
Pt 385, 200 Ω	(-200 to -80) °C	0.05 °C	Fluke 5522A
	(-80 to 0) °C	0.05 °C	
	(0 to 100) °C	0.05 °C	
	(100 to 260) °C	0.07 °C	
	(260 to 300) °C	0.2 °C	
	(300 to 400) °C	0.2 °C	
	(400 to 600) °C	0.2 °C	
	(600 to 630) °C	0.2 °C	
Pt 385, 500 Ω	(-200 to -80) °C	0.05 °C	
	(-80 to 0) °C	0.06 °C	
	(0 to 100) °C	0.06 °C	
	(100 to 260) °C	0.07 °C	
	(260 to 300) °C	0.1 °C	
	(300 to 400) °C	0.1 °C	
	(400 to 600) °C	0.1 °C	
	(600 to 630) °C	0.2 °C	
Pt 385, 1000 Ω	(-200 to -80) °C	0.04 °C	
	(-80 to 0) °C	0.04 °C	
	(0 to 100) °C	0.05 °C	
	(100 to 260) °C	0.06 °C	
	(260 to 300) °C	0.08 °C	
	(300 to 400) °C	0.08 °C	
	(400 to 600) °C	0.09 °C	
	(600 to 630) °C	0.3 °C	
Pt 3916, 100 Ω	(-200 to -190) °C	0.3 °C	
	(-190 to -80) °C	0.06 °C	
	(-80 to 0) °C	0.06 °C	
	(0 to 100) °C	0.08 °C	
	(100 to 260) °C	0.09 °C	
	(260 to 300) °C	0.1 °C	
	(300 to 400) °C	0.2 °C	
	(400 to 600) °C	0.2 °C	
Pt 3926, 100 Ω	(-200 to -80) °C	0.06 °C	
	(-80 to 0) °C	0.06 °C	
	(0 to 100) °C	0.09 °C	
	(100 to 300) °C	0.2 °C	
	(300 to 400) °C	0.2 °C	
	(400 to 630) °C	0.2 °C	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Calibration of RTD Indicators <sup>3</sup> – (cont)			
PtNi 385, 100 Ω	(-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.1 °C 0.1 °C 0.2 °C	Fluke 5522A
Cu 427, 10 Ω	(-100 to 260) °C	0.4 °C	
Thermocouple Simulation <sup>3</sup> –			
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.49 °C 0.40 °C 0.34 °C 0.36 °C	Fluke 5522A
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.52 °C 0.17 °C 0.15 °C 0.17 °C 0.22 °C	
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.24 °C 0.17 °C 0.15 °C 0.18 °C 0.24 °C	
Type K	(-200 to 100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.59 °C 0.19 °C 0.17 °C 0.26 °C 0.40 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.63 °C 0.43 °C 0.37 °C 0.43 °C	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.52 °C 0.40 °C 0.39 °C 0.48 °C	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Thermocouple Simulation <sup>3</sup> – (cont)			
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.69 °C 0.27 °C 0.19 °C 0.16 °C	Fluke 5522A

### III. Mechanical

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Torque – Measuring Devices	(0.021 to 250) ft·lbf	0.079 % Applied Load	Wheels and weights

Parameter/Equipment	Range	CMC <sup>2, 4, 5</sup> (±)	Comments
Torque <sup>3</sup> – Wrenches	(5 to 50) ft·lbf (20 to 200) ft·lbf (50 to 500) ft·lbf (100 to 1000) ft·lbf	0.66 % full scale 0.66 % full scale 0.66 % full scale 0.66 % full scale	Torque transducers
Pressure – Hydraulic	(5 to 10 000) psi	0.6 %	Ashcroft dead weight tester
Force <sup>3</sup> – Gages	Up to 1000 lbf	1.7R	Verification with ASTM class 6 weights
Transducers	Up to 1000 lbf (1000 to 50 000) lbf Up to 500 000 lbf (Compression)	0.06 % full scale 0.05 % full scale 0.09 % full scale	Load cell and meter
Analytical Balances <sup>3</sup>	(0 to 300) g	0.59 mg	Verification with Class 1 weights

Parameter/Equipment	Range	CMC <sup>2, 4, 5</sup> (±)	Comments
Balances <sup>3</sup>	(300 to 1000) g (1000 to 2000) g (2000 to 10 000) g (10 000 to 20 000) g (20 000 to 40 000) g	0.002 % 0.002 % 0.002 % 0.002 % 0.002 %	Verification with Class 1, 3 and F weights
Mass, Fixed Points	(1, 2, 3, 5) mg (10, 20, 30, 50) mg (100, 200, 300) mg 500 mg 1 g 2 g (3, 4, 5) g (10, 20) g (30, 40) g 50 g 100 g 200 g 300 g (400, 500) g 1 kg (2, 3, 4) kg 5 kg 10 kg 20 kg 25 kg  (1/32, 1/16, 1/8) oz (1/4, 1/2) oz (1, 2) oz 4 oz 8 oz 0.001 lb 0.002 lb 0.005 lb 0.01 lb 0.02 lb 0.05 lb 0.1 lb 0.2 lb 1 lb 2 lb (3, 4, 5) lb 10 lb (20, 25) lb 50 lb	0.006 mg 0.006 mg 0.007 mg 0.007 mg 0.01 mg 0.01 mg 0.01 mg 0.02 mg 0.10 mg 0.10 mg 0.10 mg 0.15 mg 20 mg 20 mg 20 mg 20 mg 22 mg 270 mg 250 mg 420 mg  0.000 004 oz 0.000 005 oz 0.000 017 oz 0.000 017 oz 0.000 17 oz 0.000 00022 lb 0.000 00015 lb 0.000 0002 lb 0.000 00015 lb 0.000 00022 lb 0.000 00031 lb 0.000 00057 lb 0.000 00075 lb 0.000 021 lb 0.000 013 lb 0.000 035 lb 0.000 044 lb 0.000 6 lb 0.000 93 lb	Comparison to Class 1 standard weights



Parameter/Equipment	Range	CMC <sup>2, 4, 5</sup> (±)	Comments
Scales <sup>3</sup>	(0 to 200 000) lb	0.02 %	Verification with Class F weights
Indirect Verification of Rockwell Hardness Testers <sup>3</sup>	HRC Low Medium High  HRBW Low Medium High	0.69 HRC 0.94 HRC 1.6 HRC  2.2 HRBW 0.66 HRBW 0.66 HRBW	Master blocks
Tachometers (Non-Contact) <sup>3</sup>	(1 to 99 999) rpm	0.00029 % + 0.58R	Fluke 5522A w/ LED Emitter
RPM (Non-Contact) - Measure <sup>3</sup>	(6 to 99 999) rpm	0.0069 % + 0.58R	Shimpo DT-2100 Tachometer

#### IV. Thermodynamics

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Temperature – Measure <sup>3</sup>	(-200 to 0) °C (0 to 350) °C  (350 to 704) °C (704 to 1250) °C	3.6 °C 1.7 °C  3.3 °C 5.8 °C	Fluke 744, SLE type T thermocouple  Fluke 744, SLE type K thermocouple
Relative Humidity	(10 to 90) % RH (90 to 98) % RH	2.9 % RH 3.6 % RH	Vaisala HMI-41/HMP -46
Temperature – Thermometers, Temperature Probes	(-20 to 150) °C	0.4 °C	Fluke 1560 Fluke 5699 Temperature baths

## V. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Stopwatches <sup>3</sup>	0.1 s to 24 hr	0.068 s	HP 53131A

<sup>1</sup> This laboratory offers commercial calibration service and field calibration service.

<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,  $R$  is the numerical value of the resolution of the device in pounds-force or in microinches, % IV indicates percentage of indicated value, and  $L$  is the numerical value of the nominal length of the device measured in inches.  $D$  is the numerical value of the nominal diameter of the device measured in inches.

<sup>5</sup> In the statement of CMC, percentages are percentage of reading, unless otherwise indicated.

<sup>6</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.



## *Accredited Laboratory*

A2LA has accredited

# GRAND RAPIDS METROLOGY

*Grand Rapids, MI*

for technical competence in the field of

## Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCCL Z540-1-1994 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 April 2017*).



Presented this 9<sup>th</sup> day of February 2018.

A handwritten signature in black ink, written over a horizontal line.

President and CEO  
For the Accreditation Council  
Certificate Number 1489.01  
Valid to October 31, 2019

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