



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

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CALIBRATION

Valid To: November 30, 2012

Certificate Number: 1995.01

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>2,7</sup> (±)	Comments
Gage Blocks	(0.01 to 1) in (2 to 4) in (5 to 20) in	(3.7 + 2.2L) μin (1.2 + 4.3L) μin (1.2 + 4.4L) μin	By mechanical comparison
Length Standards <sup>3</sup>	(1 to 20) in. flat end (21 to 80) in. flat end (1 to 20) in. spherical end (21 to 80) in. spherical end	(8.6 + 4.1L) μin (15 + 4.3L) μin (36 + 4.0L) μin (57 + 3.9L) μin	P&W 80 in LMM, supermic
Micrometers <sup>3</sup>	(0 to 1) in (1 to 40) in	(48 + 0.2L) μin (70 + 4.8L) μin	Gage blocks
Calipers <sup>3</sup>	Up to 6 in (6 to 40) in	(58 + 1.2L) μin (290 + 1.3L) μin	Gage blocks

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Ruled Standards <sup>3</sup> – Steel Rules Steel Tape	Up to 40 in Up to 100 ft	0.012 in 0.04 in	Starrett precision rule
Ring Gages <sup>3</sup>	(0.06 to 1) in (1 to 4) in (4 to 12) in	15 µin 20 µin 28 µin	Internal comparator
Thread Plug Gages - Pitch Diameter <sup>3</sup>	(4 to 80) pitch	34 µin	Van Keuren thread wires with P&W Supermic
Surface Plate Flatness <sup>3</sup>	0.0194 in Rise over 4 in 0.0155 in Rise over 4 in 0.0116 in Rise over 4 in 0.0078 in Rise over 4 in 0.0039 in Rise over 4 in 0.0019 in Rise over 4 in	110 µin 90 µin 67 µin 45 µin 22 µin 12 µin	Federal EMD-832P-50

## II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2, 6</sup> (±)	Comments
DC Voltage – Generate <sup>3,4</sup>	(0 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	8 µV/V + 0.6 µV 7 µV/V + 1.0 µV 7 µV/V + 3.8 µV 7 µV/V + 6.7 µV 8 µV/V + 82 µV 9 µV/V + 520 µV	Fluke 5700A
	(0 to 330) mV (0 to 3.3) V (0 to 33) V (30 to 330) V (100 to 1020) V	49 µV/V + 10 µV 41 µV/V + 93 µV 42 µV/V + 130 µV 46 µV/V + 840 µV 46 µV/V + 1.8 mV	Fluke 5500A

Parameter/Equipment	Range	CMC <sup>2,6</sup> ( $\pm$ )	Comments
DC Voltage – Generate, Fixed Points <sup>3,4</sup>	0.1 V	2.2 $\mu$ V/V	Datron 4910 with divider
	1 V	1.4 $\mu$ V/V	Datron 4910
	10 V	0.7 $\mu$ V/V	
	100 V	1.8 $\mu$ V/V	
	1000 V	2.2 $\mu$ V/V	Datron 4910 with divider
DC Voltage <sup>3,5</sup> – Measure	(0 to 120) mV (0.12 to 1.2) V (1.2 to 12) V (12 to 120) V (120 to 1050) V	13 $\mu$ V/V + 1 $\mu$ V 13 $\mu$ V/V + 9 $\mu$ V 12 $\mu$ V/V + 92 $\mu$ V 14 $\mu$ V/V + 89 $\mu$ V 15 $\mu$ V/V + 520 $\mu$ V	HP 3458A
	(0 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	58 $\mu$ V/V + 4 $\mu$ V 47 $\mu$ V/V + 8 $\mu$ V 41 $\mu$ V/V + 59 $\mu$ V 53 $\mu$ V/V + 710 $\mu$ V 53 $\mu$ V/V + 12 mV	HP 34401A
DC Current – Generate <sup>3,4</sup>	(0 to 220) $\mu$ A (0.22 to 22) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A	51 $\mu$ A/A + 8 nA 51 $\mu$ A/A + 8 nA 51 $\mu$ A/A + 8 nA 61 $\mu$ A/A + 0.8 $\mu$ A 82 $\mu$ A/A + 26 $\mu$ A	Fluke 5700A
	(0 to 3.3) mA (0 to 33) mA (0 to 330) mA (0 to 2.1) A (0 to 11) A	0.013 % + 92 nA 0.012 % + 1 $\mu$ A 0.020 % + 37 $\mu$ A 0.030 % + 140 $\mu$ A 0.050 % + 310 $\mu$ A	Fluke 5500A
DC Current <sup>3,5</sup> – Measure	(0 to 120) nA (0.12 to 1.2) $\mu$ A (1.2 to 12) $\mu$ A (12 to 120) $\mu$ A (0.12 to 1.2) mA (1.2 to 12) mA (12 to 120) mA (0.12 to 1.05) A	62 $\mu$ A/A + 8 nA 56 $\mu$ A/A + 8 nA 56 $\mu$ A/A + 8 nA 56 $\mu$ A/A + 8 nA 56 $\mu$ A/A + 10 nA 56 $\mu$ A/A + 82 nA 73 $\mu$ A/A + 820 nA 0.015 % + 26 nA	HP 3458A
	(0 to 20) A	8.9 $\mu$ A/A	Fluke Y5020 shunt

Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments			
DC Current <sup>3,5</sup> – Measure (cont)	(0 to 10) mA (10 to 100) mA (0.1 to 1) A (1 to 3) A	0.06 % + 2 µA 0.06 % + 6 µA 0.12 % + 0.12 mA 0.15 % + 0.8 mA	HP 34401A			
	(0 to 1000) A	0.32 %	HP 3458A with current shunts			
Resistance – Generate <sup>3,4</sup>	Fixed Points  0 Ω (1, 1.9) Ω 10 Ω 19 Ω (100, 190) Ω (1, 1.9) kΩ (10, 19) kΩ (100, 190) kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	58 µΩ 110 µΩ/Ω 34 µΩ/Ω 32 µΩ/Ω 21 µΩ/Ω 15 µΩ/Ω 15 µΩ/Ω 17 µΩ/Ω 24 µΩ/Ω 25 µΩ/Ω 47 µΩ/Ω 56 µΩ/Ω 0.013 %	Fluke 5700A			
		Range	(0 to 11) Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω (0.33 to 1.1) kΩ (1.1 to 3.3) kΩ (3.3 to 11) kΩ (11 to 33) kΩ (33 to 110) kΩ (110 to 330) kΩ (0.33 to 1.1) MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ	99 µΩ/Ω + 6 mΩ 96 µΩ/Ω + 12 mΩ 73 µΩ/Ω + 12 mΩ 72 µΩ/Ω + 12 mΩ 72 µΩ/Ω + 48 mΩ 72 µΩ/Ω + 48 mΩ 72 µΩ/Ω + 0.5 Ω 72 µΩ/Ω + 0.5 Ω 87 µΩ/Ω + 4.8 Ω 97 µΩ/Ω + 5.0 Ω 0.012 % + 44 Ω 0.014 % + 120 Ω 0.05 % + 460 Ω 0.1 % + 1 kΩ 0.4 % + 5 kΩ	Fluke 5500A	
			By Decades	(1 to 10) Ω	3.9 µΩ/Ω	ESI SR1010
				(0.1 to 1) kΩ (1 to 10) kΩ	0.95 µΩ/Ω 0.7 µΩ/Ω	ESI SR104
				(0.1 to 1) MΩ (10 to 100) MΩ	1.1 µΩ/Ω 8.2 µΩ/Ω	ESI SR1050

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Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
Resistance <sup>3,5</sup> – Measure	(0 to 12) Ω (12 to 120) Ω (0.12 to 1.2) kΩ (1.2 to 12) kΩ (12 to 120) kΩ (0.12 to 1.2) MΩ (1.2 to 12) MΩ (12 to 120) MΩ	33 μΩ/Ω + 59 μΩ 22 μΩ/Ω + 580 μΩ 18 μΩ/Ω + 590 μΩ 17 μΩ/Ω + 6 mΩ 18 μΩ/Ω + 59 mΩ 27 μΩ/Ω + 2 Ω 71 μΩ/Ω + 120 Ω 0.06 % + 1 kΩ	HP 3458A
	(0 to 100) Ω (0.1 to 1) kΩ (1 to 10) kΩ (10 to 100) kΩ (0.1 to 1) MΩ (1 to 10) MΩ (0 to 100) MΩ	0.012 % + 0.11 mΩ 0.012 % + 12 mΩ 0.012 % + 0.12 Ω 0.012 % + 2 Ω 0.012 % + 12 Ω 0.05 % + 120 Ω 0.9 % + 12 kΩ	HP 34401A
Capacitance – Generate <sup>3,4</sup>	(0.33 to 0.5) nF (0.5 to 1.1) nF (1.1 to 3.3) nF (3.3 to 11) nF (11 to 33) nF (33 to 110) nF (110 to 330) nF (0.33 to 1.1) μF (1.1 to 3.3) μF (3.3 to 11) μF (11 to 33) μF (33 to 110) μF	0.58 % + 12 pF 0.58 % + 12 pF 0.58 % + 12 pF 0.58 % + 12 pF 0.29 % + 120 pF 0.29 % + 120 pF 0.29 % + 350 pF 0.29 % + 1 nF 0.40 % + 4 nF 0.40 % + 12 nF 0.46 % + 35 nF 0.60 % + 120 nF	Fluke 5500A
Electrical Calibration of Thermocouple Indicator – Generate and Measure <sup>3,4</sup>  Type E	-250 °C to -100 °C -100 °C to -25 °C -25 °C to 350 °C 350 °C to 650 °C 650 °C to 1000 °C	0.58 °C 0.19 °C 0.16 °C 0.18 °C 0.24 °C	Fluke 5500A

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Calibration of Thermocouple Indicator – Generate and Measure <sup>3,4</sup> (cont.)			
Type J	-210 °C to -100 °C -100 °C to -30 °C -30 °C to 150 °C 150 °C to 760 °C 760 °C to 1200 °C	0.31 °C 0.19 °C 0.16 °C 0.2 °C 0.27 °C	Fluke 5500A
Type K	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 1000 °C 1000 °C to 1372 °C	0.38 °C 0.21 °C 0.19 °C 0.3 °C 0.46 °C	
Type R	0 °C to 250 °C 250 °C to 400 °C 400 °C to 1000 °C 1000 °C to 1767 °C	0.66 °C 0.4 °C 0.38 °C 0.46 °C	
Type S	0 °C to 250 °C 250 °C to 1000 °C 1000 °C to 1400 °C 1400 °C to 1767 °C	0.54 °C 0.42 °C 0.43 °C 0.53 °C	
Type T	-250 °C to -150 °C -150 °C to 0 °C 0 °C to 120 °C 120 °C to 400 °C	0.73 °C 0.28 °C 0.19 °C 0.16 °C	
Electrical Calibration of RTD Indicator – Generate <sup>3,4</sup>			
Pt 385, 100 Ω	-200 °C to -80 °C -80 °C to 0 °C 0 °C to 100 °C 100 °C to 300 °C 300 °C to 400 °C 400 °C to 630 °C 630 °C to 800 °C	0.059 °C 0.059 °C 0.082 °C 0.11 °C 0.12 °C 0.14 °C 0.27 °C	Fluke 5500A

Parameter/Range	Frequency	CMC <sup>2,6</sup> (±)	Comments
AC Voltage – Generate <sup>3,4</sup>			
(0.2 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 (0.5 to 1) MHz	0.056 % + 4.6 μV 0.022 % + 4.6 μV 0.011 % + 4.6 μV 0.038 % + 4.6 μV 0.087 % + 7.1 μV 0.11 % + 13 μV 0.17 % + 26 μV 0.35 % + 26 μV	Fluke 5700A
(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 (0.5 to 1) MHz	0.056 % + 5.1 μV 0.021 % + 5.1 μV 0.011 % + 5.1 μV 0.038 % + 5.1 μV 0.087 % + 7.1 μV 0.11 % + 12 μV 0.17 % + 26 μV 0.35 % + 26 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 (0.5 to 1) MHz	0.056 % + 13 μV 0.021 % + 8 μV 0.011 % + 8 μV 0.038 % + 8 μV 0.087 % + 26 μV 0.11 % + 26 μV 0.17 % + 36 μV 0.35 % + 82 μV	
(0.22 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 (0.5 to 1) MHz	0.051 % + 82 μV 0.016 % + 26 μV 77 μV/V + 6 μV 0.012 % + 16 μV 0.026 % + 71 μV 0.044 % + 130 μV 0.11 % + 360 μV 0.22 % + 870 μV	

Parameter/Range	Frequency	CMC <sup>2,6</sup> (±)	Comments
AC Voltage – Generate <sup>3,4</sup> (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 (0.5 to 1) MHz	0.051 % + 820 μV 0.016 % + 260 μV 77 μV/V + 62 μV 0.012 % + 160 μV 0.026 % + 360 μV 0.051 % + 2 mV 0.13 % + 4 mV 0.28 % + 9 mV	Fluke 5700A
AC Current – Generate <sup>3,4</sup>  (0 to 220) μA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.071 % + 26 nA 0.036 % + 20 nA 0.014 % + 16 nA 0.061 % + 41 nA 0.16 % + 82 nA	Fluke 5700A
(0.22 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	0.071 % + 42 nA 0.036 % + 38 nA 0.014 % + 38 nA 0.061 % + 41 nA 0.16 % + 82 nA	
(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	0.071 % + 420 nA 0.036 % + 380 nA 0.014 % + 380 nA 0.061 % + 4.1 μA 0.16 % + 8.2 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	0.071 % + 4.2 μA 0.036 % + 3.8 μA 0.014 % + 3.8 μA 0.061 % + 41 μA 0.16 % + 82 μA	

Parameter/Range	Frequency	CMC <sup>2,6</sup> (±)	Comments
AC Current – Generate <sup>3,4</sup> (cont.)			
(0.22 to 2.2) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.066 % + 38 µA 0.077 % + 82 µA 0.87 % + 160 µA	Fluke 5700A
(0.03 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	0.51 % + 300 nA 0.21 % + 300 nA 0.12 % + 550 nA 0.32 % + 550 nA 1.9 % + 9.6 µA	Fluke 5500A
(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	0.50 % + 2.8 µA 0.20 % + 2.7 µA 0.11 % + 2.7 µA 0.18 % + 6.7 µA 2.4 % + 12 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	0.50 % + 28 µA 0.20 % + 27 µA 0.10 % + 54 µA 0.18 % + 37 µA 1.7 % + 130 µA	
(33 to 330) mA	(20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.22 % + 270 µA 0.17 % + 270 µA 0.22 % + 280 µA 1.9 % + 360 µA	
(0.33 to 2.2) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz	0.26 % + 360 µA 0.22 % + 360 µA 0.60 % + 370 µA	
(2.2 to 11) A	(45 to 65) Hz (65 to 500) Hz (0.5 to 1) kHz	0.05 % + 1.8 mA 0.08 % + 1.8 mA 0.26 % + 1.8 mA	

Parameter/Range	Frequency	CMC <sup>2,6</sup> (±)	Comments
AC Voltage <sup>3,5</sup> – Measure			
(0 to 12) 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	0.066 % + 5.7 μV 0.026 % + 5.2 μV 0.036 % + 5.2 μV 0.12 % + 5.2 μV 0.58 % + 7.1 μV 4.6 % + 12 μV	HP 3458A
(12 to 120) 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 (0.3 to 1) MHz	0.057 % + 13 μV 0.014 % + 8.3 μV 0.019 % + 8.3 μV 0.051 % + 8.3 μV 0.051 % + 8.3 μV 1.2 % + 28 μV 3.7 % + 81 μV	
(0.12 to 1.2) 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 (0.3 to 1) MHz	0.052 % + 92 μV 0.011 % + 24 μV 0.018 % + 24 μV 0.037 % + 28 μV 0.096 % + 74 μV 0.35 % + 170 μV 1.2 % + 860 μV	
(1.2 V to 12) 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 (0.3 to 1) MHz	0.052 % + 9.2 μV 0.011 % + 240 μV 0.018 % + 240 μV 0.037 % + 280 μV 0.096 % + 420 μV 0.35 % + 1.9 mV 1.2 % + 8.6 mV	
(12 to 120) 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 (0.3 to 1) MHz	0.056 % + 9.2 mV 0.025 % + 2.4 mV 0.025 % + 2.4 mV 0.046 % + 4.4 mV 0.15 % + 8.3 mV 0.49 % + 90 mV 2.1 % + 190 mV	
(120 to 1050) V	(1 to 40) Hz	0.047 % + 23 mV	

Parameter/Range	Frequency	CMC <sup>2,6</sup> (±)	Comments
AC Voltage <sup>3</sup> – Measure (cont)			
100 mV	(3 to 5) Hz (5 to 10) Hz 10 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	1.2 % + 48 uV 0.41 % + 48 uV 0.07 % + 47 uV 0.14 % + 58 uV 0.70 % + 96 uV 4.8 % + 580 uV	HP 34401A
(1 to 220) V	(3 to 5) Hz (5 to 10) Hz 10 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	1.2 % + 77 mV 0.41 % + 77 mV 0.07 % + 76 mV 0.14 % + 130 mV 0.70 % + 200 mV 4.6 % + 1.3 V	
(220 to 750) V	(50 to 100) kHz	0.07 % + 3.9 mV	
AC Current <sup>3,5</sup> – Measure			
(0 to 120) µA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 1) kHz	0.47 % + 34 nA 0.18 % + 31 nA 0.07 % + 31 nA 0.07 % + 28 nA	HP 3458A
(0.12 to 120) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz (5 to 20) kHz	0.47 % + 230 nA 0.18 % + 230 nA 0.07 % + 230 nA 0.07 % + 460 nA 1.6 % + 8.3 µA	
(0.12 to 12) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz (5 to 20) kHz	0.47 % + 2.3 µA 0.18 % + 2.3 µA 0.07 % + 2.3 µA 0.07 % + 4.6 µA 1.6 % + 8.3 µA	
(12 to 120) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz (5 to 20) kHz	0.47 % + 23 µA 0.18 % + 23 µA 0.071 % + 23 µA 0.070 % + 46 µA 1.6 % + 83 µA	

Parameter/Range	Frequency	CMC <sup>2,6</sup> (±)	Comments
AC Current <sup>3,5</sup> – Measure (cont)			
(0.12 to 1.05) A	(20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz (5 to 20) kHz	0.20 % + 230 µA 0.11 % + 230 µA 0.14 % + 230 µA 0.93 % + 280 µA	HP 3458A
(0 to 1) A	(3 to 5) Hz (5 to 10) Hz 10 Hz to 5 kHz	1.2 % + 590 µA 0.4 % + 590 µA 0.6 % + 590 µA	HP 34401A
(0 to 3) A	(3 to 5) Hz (5 to 10) Hz 10 Hz to 5 kHz	1.3 % + 2.7 mA 0.4 % + 2.7 mA 0.3 % + 2.7 mA	HP 34401A
(0 to 20) A	DC to 5 kHz	0.013 %	Fluke Y5020 shunt

### III. Mechanical

Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
Torque Wrenches <sup>3</sup>	(5 to 20) in·lb (50 to 250) in·lb (25 to 2000) ft·lb	2.2 % 1.4 % 1.3 %	CDI torque tester
Absolute Pressure <sup>3</sup>	(0 to 30) psia	0.0054 psia	Mensor 2101 DPG

Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
Pressure Gauges <sup>3</sup>	(4 to 854) inH <sub>2</sub> O (1 to 30) psi	0.011 %	Ametek PKII deadweight tester
	(4 to 1100) inH <sub>2</sub> O (1 to 300) psi	0.011 %	Ametek RK deadweight tester
	(0.1 to 17.5) psi (1.7 to 70) psi (2 to 700) psi	0.013 % 0.013 % 0.016 %	Ruska 2465
	(100 to 2500) psi	0.01 %	Ruska 2470
	(6 to 2400) psi (30 to 12 000) psi	0.0055 % 0.0070 %	Ruska 2400
	(100 to 1500) psi (500 to 7500) psi (1000 to 15 000) psi	0.0096 % 0.012 % 0.012 %	Ametek type T
Mass <sup>3</sup>	(1 to 3) lb (4 to 5) lb (10 to 25) lb (30 to 50) lb	0.003 g (6.7 µlb) 0.03 g (67 µlb) 0.5 g (1200 µlb) 0.33 g (730 µlb)	Mass standards calibrated with digital scales using the single substitution method
	(0.0005 to 0.3) oz (0.5 to 1) oz (2 to 4) oz (4 to 8) oz	0.06 mg (0.13 µlb) 0.08 mg (0.18 µlb) 0.3 mg (0.67 µlb) 3.4 mg (7.5 µlb)	
	1 mg to 20 g (20 to 50) g (50 to 100) g	0.006 mg 0.09 mg 0.34 mg	
	(0 to 100) g (100 to 200) g (200 to 400) g	0.06 mg 0.3 mg 0.01 g	
	(1 to 1.2) kg (0.5 to 2) kg (2 to 4) kg	0.03 g 0.05 g 0.1 g	
	(4 to 12) kg (12 to 30) kg	0.6 g 0.8 g	

IV. Thermodynamics

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Temperature – Generate			
Triple Point of Water Cell	0.01 °C	0.001 °C	Hart 5901A
Temperature Bath	-40 °C to 60 °C 60 °C to 100 °C 100 °C to 250 °C	0.018 °C 0.022 °C 0.033 °C	Hart 5628 PRT Hart 7341 Hart 6331 Hart 9173
Temperature – Measure <sup>3</sup>	-200 °C to 660 °C -200 °C to 660 °C  0 °C to 1000 °C 1000 °C to 1100 °C 1100 °C to 1200 °C 1200 °C to 1300 °C 1300 °C to 1450 °C	0.015 °C 0.016 °C  0.37 °C 0.9 °C 1.5 °C 2.1 °C 2.9 °C	Hart 5628 PRT  Hart 5650 with type S thermocouple

V. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
Frequency <sup>3</sup> – Measure	(1 to 40) Hz 40 Hz to 10 MHz  (3 to 5) Hz (5 to 10) Hz (10 to 40) Hz 40 Hz to 300 kHz  DC to 50 MHz  Up to 2.7 GHz	0.059 % 0.016 %  0.12 % 0.06 % 0.04 % 0.02 %  7.6 parts in 10 <sup>4</sup>  1.8 parts in 10 <sup>8</sup>	HP 3458A  HP 34401A  HP 5245L Fluke PM 6681

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

- <sup>2</sup> Calibration and Measurement Capability (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 Generate . Calibration and Measurement Capabilities 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. Field environmental conditions are limited to 15 °C to 30 °C and <80% relative humidity to 30 °C.
- <sup>4</sup> Fluke 5700A and 5500A CMCs are based upon the temperature the standard was calibrated ( $t_{cal} \pm 5$  °C) and assuming the instrument is zeroed at least every seven days or when the ambient temperature changes more than 5 °C. For Resistance, a zero calibration is performed at least every 12 hours within  $\pm 1$  °C of use. For AC Current, best uncertainties are determined with the LCOMP off. CMCs are also based upon 1-year floor specifications. CMCs are expressed as either a specific value that covers the full range or as a fraction of the reading plus a fixed floor specification.
- <sup>5</sup> HP 3458A CMCs are based upon the temperature the standard was calibrated ( $t_{cal} \pm 5$  °C) and an auto calibration (ACAL) was performed within the previous 24 hours ( $\pm 1$  °C of ambient temperature.) CMCs are also based upon 1-year floor specifications. CMCs are expressed as either a specific value that covers the full range or as a combination of the fraction of the reading/output plus a range specification.
- <sup>6</sup> In the statement of CMC, percentages are percentages of reading, unless otherwise indicated.
- <sup>7</sup> In the statement of CMC,  $L$  is the numerical value of the nominal length in inches.