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

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CALIBRATION

Valid To: August 31, 2010 Certificate Number: 1022.03

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations[1]:

I. Mechanical

Parameter/Equipment	Range	Best Uncertainty[2, 3, 4, 6] (±)		Comments
		Laboratory	On-Site	
Mass Measurement	(30 to 4000) g (4 to 31) kg	0.04 g 0.30 g	See Footnote 5	Electronic balance, Class 6 limited
Balances Scales	1 mg to 7.4 kg 1 mg to 220 g 1 mg to 220 g 2 mg to 38 kg 0.1 oz to 3700 lb	2.6 µg/g + 0.6*R* 5 µg/g + 0.6*R* 10 µg/g + 0.6*R* 0.01 % + 0.6*R* 90 µg/g + 0.6*R*	See Footnote 5 See Footnote 5	Handbook 44 with: Class 1 weights Class 2 weights Class 3 weights Class F weights Class 6 weights
Force – Compression & Tension	(0 to 1000) lbf (1000 to 2000) lbf (2000 to 5000) lbf (5000 to 10 000) lbf (10 000 to 20 000) lbf	0.025 % 0.57 lbf 1.1 lbf 2.2. lbf 5.5 lbf	See Footnote 5	Class 6 weights/DMM Standard load cells
Torque Tools	(20 to 160) ozf·in (10 to 100) lbf·in (8 to 30) lbf·ft (30 to 300) lbf·ft	0.42 % + 0.01 ozf·in 0.17 % 0.21 % + 0.02 lbf·ft 0.24 %	See Footnote 5	AKO TSD-650-P torque transducer calibration system

Parameter/Equipment	Range	Best Uncertainty[2, 3, 4, 6] (±)		Comments
		Laboratory	On-Site	
Pressure – Gages and Transducers	(0 to 2) inH_2O	0.005 inH_2O + 0.6*R*	See Footnote 5	Dwyer hook gauge
	(0.5 to 23) psia	0.0093 % + 0.0004 psi	See Footnote 5	DHI RPM 4
	(23 to 1015) psia	0.0093 % + 0.6*R*	See Footnote 5	DHI PPC3
	(100 to 10 000) psi	0.1 % + 0.2 psi	See Footnote 5	Ametek dead weight tester
"Direct Verification" of Durometers –				ASTM D2240 using:
Spring Force	A, B, O, D, C, DO scales	0.6 points	See Footnote 5	Shore durocalibrator
Indenter Shape		Pass/Fail		Microscope
Indirect Verification of Rockwell Hardness Testers	HRC: (20 to 39) HRC (40 to 59) HRC (60 to 70) HRC	 0.43 HRC 0.54 HRC 0.53 HRC	See Footnote 5	ASTM E-18 w/ traceable blocks
Extrusion Plastometer –				ASTM D1238 using:
Piston Diameter	---	65 µin	See Footnote 5	Micrometer
Cylinder/Bore Dia.	---	120 µin		Micrometer
Timer	---	0.0023 s		Counter
Mass	---	0.04 g		Digital balance
Switch Travel	---	0.0012 in		Caliper
Temperature	< 300 °C ≥ 300 °C	0.027 °C 0.031 °C		PRT

II. Dimensional

Parameter/Equipment	Range	Best Uncertainty[2, 3, 6] (±)		Comments
		Laboratory	On-Site	
Length Standards	(0.5 to 24) in	14 µin/in + 28 µin	See Footnote 5	Gage blocks and height comparator
Linear Displacement Measuring Equipment	(0 to 24) in (1 to 50) ft	60 µin/in + 0.0027 in 0.27 % + 0.06 in	See Footnote 5 See Footnote 5	Mitutoyo 574-210 Starrett C530-CI

Parameter/Equipment	Range	Best Uncertainty[2, 3, 4] (±)		Comments
		Laboratory	On-Site	
Plain, External Diameter	(0.03 to 2.36) in	20 µin	See Footnote 5	Laser micrometer
Calipers	(0.0005 to 72) in	13 µin/in + 0.6*R*	See Footnote 5	Gage blocks
Indicators	(0.0005 to 6) in	0.001 in/in + 0.6*R*	See Footnote 5	Gage blocks
Micrometers	(0.001 to 40) in	13 µin/in + 0.6*R*	See Footnote 5	Gage blocks
Height Gages	(0.001 to 48) in	13 µin/in + 0.6*R*	See Footnote 5	Gage blocks
Angle – Measuring Equipment	0° to 60° 90° ± 3' Up to 360°	8.0" + 0.6*R* 5.4" 6.2" + 0.6*R*	Not Available Not Available See Footnote 5	Gage blocks, sine bar Cylinder square Angle encoder
Optical Comparators –				Comparison to master
Linear Travel	Up to 30 in	120 µin	See Footnote 5	Scales
Magnification	10X to 100X	0.0011 in	See Footnote 5	Magnification checker and spheres
Flatness	Up to 3 in diameter (3 to 6) in diameter	11 µin 4.9 µin	See Footnote 5	Optical flats
Steel Tapes	(1 to 50) ft	0.08 in	Not Available	Master tape

III. Time & Frequency

Parameter/Equipment	Range	Best Uncertainty[2, 3, 4] (±)		Comments
		Laboratory	On-Site	
Frequency Measuring Equipment	1 mHz to 50 GHz	1.2 parts in 10^{10} + 0.6R	See Footnote 5	Symmetricom 8040 Rb oscillator and 3325B or PSG E4438C

Parameter/Equipment	Range	Best Uncertainty[2, 3, 4] (±)		Comments
		Laboratory	On-Site	
Frequency – Measure	1 mHz to 40 GHz	1.2 parts in 10^{10} + 0.6*R*	See Footnote 5	Symmetricom 8040 Rb oscillator locked to 53132A, 53152B or E44458A

IV. Electrical – RF & Microwave

Parameter/Range	Frequency	Best Uncertainty[2, 3, 6] (±)		Comments
		Laboratory	On-Site	
Power Meter – Power Reference @ 1 mW	50 MHz	1.9 % + *M*	See Footnote 5	Power transfer using HP 432A, 478A-H76 In the best uncertainty, *M* is the source mismatch uncertainty
Power Sensor Calibration Factor –				HP 438A with:
(-30 to +20) dBm	100 kHz to 4.2 GHz	1.6 %	See Footnote 5	HP 8482-H84
	10 MHz to 14 GHz (14 to 18) GHz	1.6 % 1.8 %		HP8481A-H84
	(2 to 18) GHz (18 to 26.5) GHz	1.9 % 2.8 %		HP 8485A-H84
Amplitude Modulation –				
Carrier: (0.15 to 10) MHz Depth: Up to 99 %	(20 to 50) Hz 50 Hz to 100 kHz	3.5 % 2.4 %	See Footnote 5	HP 8902A
Carrier: 10 MHz to 1.3 GHz Depth: Up to 99 %	(20 to 50) Hz 50 Hz to 100 kHz	3.3 % 3.5 %	See Footnote 5	
Frequency Modulation –				
Carrier: 250 kHz to 10 MHz Dev: Up to 40 kHz	20 Hz to 10 kHz	2.4 %	See Footnote 5	HP 8902A
Carrier: 10 MHz to 1.3 GHz Dev: Up to 400 kHz	(20 to 50) Hz 50 Hz to 100 kHz (100 to 200) kHz	2.3 % 1.2 % 5.8 %	See Footnote 5	

Parameter/Range	Frequency	Best Uncertainty[2, 3, 6] (±)		Comments
		Laboratory	On-Site	
Phase Modulation –				
Carrier: 150 kHz to 10 MHz	200 Hz to 10 kHz	4.7 %	See Footnote 5	HP 8902A
Carrier: 10 MHz to 1.3 GHz	200 Hz to 20 kHz	3.6 %	See Footnote 5	
Relative Power – Measure				
(0 to -10) dBm (-10 to -20) dBm (-20 to -30) dBm (-30 to -40) dBm (-40 to -50) dBm (-50 to -60) dBm (-60 to -70) dBm (-70 to -80) dBm (-80 to -90) dBm (-90 to -100) dBm	10 MHz to 26.5 GHz	0.05 dB 0.05 dB 0.06 dB 0.11 dB 0.11 dB 0.12 dB 0.14 dB 0.21 dB 0.30 dB 0.37 dB	See Footnote 5	HP 8902A
Absolute Power – Measure				HP E4448A or 438A with:
(-70 to -30) dBm	10 MHz to 18 GHz	2.9 % + *M*	See Footnote 5	HP 8484A, N-type
(-30 to +10) dBm	100 kHz to 4.2 GHz (4.2 to 18) GHz (18 to 26.5) GHz (26.5 to 50) GHz	1.8 % + *M* 2.7 % + *M* 3.2 % + *M* 2.8 dB + *M*	See Footnote 5	HP 8482A H85, N-type HP 8481A H85, N-type HP 8485A H85, 3.5 mm E4448A, 2.4 mm
(+10 to +20) dBm	100 kHz to 4.2 GHz (4.2 to 18) GHz (18 to 26.5) GHz (26.5 to 50) GHz	4 % + *M* 4.3 % + *M* 4.3 % + *M* 2.8 dB + *M*	See Footnote 5	HP 8482A H85, N-type HP 8481A H85, N-type HP 8485A H85, 3.5 mm E4448A, 2.4 mm In the best uncertainty, *M* is the source mismatch uncertainty.

Parameter/Equipment	Range	Best Uncertainty[2, 3] (±)		Comments
		Laboratory	On-Site	
Reflection S_{11}/S_{22} – Measure				
Type-N connecters 30 kHz to 2 GHz	Linear Phase Linear Mag.	(± 2.5 to ± 11) ° ± 0.33 dB	Not Available	Agilent 8753D VNA w/ 85032B Cal kit
(2 to 6) GHz	Linear Phase Linear Mag.	(± 13 to ± 16) ° ±1.6 dB		
Transmission S_{12}/S_{21} – Measure				
Type-N connecters 30 kHz to 2 GHz	Linear Phase Linear Mag.	(± 0.61 to ± 45) ° (± 0.11 to ± 9.5) dB	Not Available	Agilent 8753D VNA w/ 85032B Cal kit
(2 to 6) GHz	Linear Phase Linear Mag.	(± 0.60 to ± 45) ° (± 0.12 to ± 9.5) dB		
Single Side Band-Phase Noise – Measure				
Carrier: 10 Hz to 100 MHz Offset Freq:	Noise Floor: (approximately)			
10 Hz	-80 dB	3.0 dB		Agilent E4440A Opt 226 Noise floor for any given frequency may be degraded due to SSB noise floor of the reference generator
100 Hz	-95 dB	2.2 dB		
1 kHz	-110 dB	1.1 dB		
10 kHz	-118 dB	0.76 dB		
100 kHz	-118 dB	0.87 dB		
1 MHz	-118 dB	0.46 dB		
10 MHz	-145 dB	0.46 dB		
100 MHz	-150 dB	0.46 dB		

V. Electrical – DC & Low Frequency

Parameter/Equipment	Range	Best Uncertainty[2, 3] (±)		Comments
		Laboratory	On-Site	
DC Voltage – Measure and Generate	(0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1000) V	9 µV/V + 0.4 µV 5.4 µV/V + 0.4 µV 4.1 µV/V + 0.7 µV 6.3 µV/V + 36 µV 7.3 µV/V + 160 µV	See Footnote 5	HP 3458A opt 002 with Fluke 5700A
Fixed Points	100 mV to 1100 V	7.3 µV/V + 160 µV	Not Available	Fluke 732B/752A

Parameter/Equipment	Range	Best Uncertainty[2, 3, 6] (±)		Comments
		Laboratory	On-Site	
DC Voltage – Generate	(0 to 220) mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V	7.5 µV/V + 0.7 µV 6.6 µV/V + 1.2 µV 6.8 µV/V + 4 µV 7.7 µV/V + 9.3 µV 8.5 µV/V + 93 µV 8.6 µV/V + 0.58 mV	See Footnote 5	Fluke 5700A
DC Voltage – Measure	(0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1000) V	5.7 µV/V + 0.4 µV 5.4 µV/V + 0.4 µV 3.1 µV/V + 0.7 µV 5.3 µV/V + 35 µV 5.3 µV/V + 120 µV	See Footnote 5	HP 3458A opt 002
DC High Voltage – Measure Generate	(1 to 60) kV (1 to 40) kV	0.17 % 0.17 %	See Footnote 5	Ross divider and DVM
DC Current – Generate	0.1 nA to 220 µA (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 (11 to 20) A (11 to 100) A (100 to 1000) A	47 µA/A + 9.2 nA 76 µA/A + 29 nA 47 µA/A + 83 nA 49 µA/A + 0.92 µA 76 µA/A + 29 µA 0.04 % + 0.56 mA 0.16 % + 0.4 mA 0.3 % + 60 mA	See Footnote 5 0.16 % + 0.87 mA	Fluke 5700A Fluke 5520A Fluke 5700/5220A Fluke 5500A/coil
DC Current– Measure	(10 to 100) µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A (1 to 10) A (10 to 100) A (30 to 300) A (11 to 1000) A	18 µA/A + 1 nA 19 µA/A + 6 nA 21 µA/A + 60 nA 40 µA/A + 0.6 µA 58 µA/A + 12 µA 0.31 mA 33 µA/A 0.011 % 0.13 %	See Footnote 5 See Footnote 5	HP 3458A opt 002; uncertainty stated as percent of reading plus floor specification. w/ L&N 4222 w/ L&N 4361 w/ L&N 4363 w/ RAM shunt

Parameter/Equipment	Range	Best Uncertainty[2, 3, 6] (±)		Comments
		Laboratory	On-Site	
DC Resistance – Generate, Fixed Values	1 Ω 1.9 Ω 10 Ω 19 Ω (100, 190) Ω 1 kΩ 1.9 kΩ (10, 19) kΩ (100, 190) kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ	0.011 % 0.011 % 33 parts in 10^6 31 parts in 10^6 20 parts in 10^6 14 parts in 10^6 15 parts in 10^6 13 parts in 10^6 16 parts in 10^6 22 parts in 10^6 23 parts in 10^6 43 parts in 10^6 55 parts in 10^6	See Footnote 5	Fluke 5700A
	100 MΩ	0.014 %	Not available	L&N 4015-B
	0.1 Ω	26 parts in 10^6	Not available	Fluke 742A series fixed resistors
	(1, 1.9, 10) Ω 100 Ω, 1 kΩ (10, 19) kΩ 100 kΩ 1 MΩ 10 MΩ 19 MΩ	9 parts in 10^6 7 parts in 10^6 5 parts in 10^6 8 parts in 10^6 11 parts in 10^6 16 parts in 10^6 26 parts in 10^6		
	1 GΩ 10 GΩ 100 GΩ	0.11 % 1.0 % 6.7 %	See Footnote 5	Keithley resistors
Resistance – Measure	(0.1 to 1) Ω (1 to 1.9) Ω (1.9 to 10) Ω (10 to 100) Ω (0.1 to 1) kΩ (1 to 10) kΩ (10 to 19) kΩ (19 to 100) kΩ (0.1 to 1) MΩ (1 to 10) MΩ (10 to 19) MΩ (19 to 100) MΩ	60 μΩ/Ω 16 μΩ/Ω 13 μΩ/Ω 14 μΩ/Ω 14 μΩ/Ω 4.8 μΩ/Ω 4.8 μΩ/Ω 4.9 μΩ/Ω 7.3 μΩ/Ω 10 μΩ/Ω 13 μΩ/Ω 20 μΩ/Ω	Not Available	Fluke 5700A, HP 3458A and 742A series resistors

Parameter/Equipment	Range	Best Uncertainty[2, 3, 6] (±)		Comments
		Laboratory	On-Site	
Resistance – Measure (cont)	(0 to 10) Ω (10 to 100) Ω (100 to 1000) Ω (1 to 10) kΩ (10 to 100) kΩ (100 to 1000) kΩ (1 to 10) MΩ (10 to 100) MΩ (0.1 to 1) GΩ	26 μΩ/Ω + 64 μΩ 17 μΩ/Ω + 0.59 mΩ 12 μΩ/Ω + 0.64 mΩ 18 μΩ/Ω + 6.4 mΩ 13 μΩ/Ω + 64 mΩ 20 μΩ/Ω + 2.4 Ω 67 μΩ/Ω + 120 Ω 0.063 % + 1.2 kΩ 0.7 % + 12 kΩ	See Footnote 5	HP 3458A
	(1 to 1000) GΩ	0.46 %	See Footnote 5	Keithley 487
AC Voltage – Measure and Generate				HP 3458A opt 002 with 5700A
(0.01 to 10) mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (0.1 to 1) MHz	0.035 % + 4 μV 0.024 % + 2 μV 0.035 % + 2 μV 0.12 % + 2 μV 0.58 % + 2 μV 4.6 % + 3 μV	See Footnote 5	Uncertainties stated as percent of reading plus floor specification
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 (0.3 to 1) MHz (1 to 2) MHz	90 μV/V + 50 μV/V 90 μV/V + 30 μV/V 0.017 % + 30 μV/V 0.035 % + 30 μV/V 0.093 % + 30 μV/V 0.35 % + 0.012 % 1.2 % + 0.012 % 1.8 % + 0.012 %		Uncertainties stated as percent or part of reading plus percent or part of range
(10 to 100) V	(1 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz	0.024 % + 4.7 mV 0.024 % + 2.3 mV 0.041 % + 2.3 mV 0.14 % + 2.3 mV 0.47 % + 12 mV 1.8 % + 12 mV		Uncertainties stated as percent of reading plus floor specification
(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	0.074 % + 48 mV 0.074 % + 24 mV 0.092 % + 24 mV 0.16 % + 24 mV 0.36 % + 24 mV		
AC High Voltage – Measure				
(1 to 42) kV	60 Hz	0.61 %	See Footnote 5	Ross divider and DVM

Parameter/Range	Frequency	Best Uncertainty[2, 3] (±)		Comments
		Laboratory	On-Site	
AC Current – Generate				Fluke 5700A
(9 to 220) µA	(1 to 5) kHz (5 to 10) kHz	0.07 % + 60 nA 0.19 % + 100 nA	See Footnote 5	Uncertainties stated as percent of reading plus floor specification
100 µA to 2.2 mA (2.2 to 22) mA (22 to 220) mA	(5 to 10) kHz (5 to 10) kHz (5 to 10) kHz	0.19 % + 1 µA 0.19 % + 10 µA 0.19 % + 100 µA		
220 mA to 2.2 A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.076 % + 50 µA 0.087 % + 0.1 mA 1.1 % + 0.2 mA		
(2.2 to 11) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.05 % + 0.2 mA 0.1 % + 0.4 mA 0.39 % + 0.9 mA	See Footnote 5	with 5725A
(11 to 20) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.14 % + 5.8 mA 0.18 % + 5.8 mA 3.6 % + 5.8 mA	See Footnote 5	with 5520A
AC Current – Measure				HP 3458A
(5 to 100) µA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz	0.46 % + 0.035 µA 0.18 % + 0.035 µA 0.07 % + 0.035 µA	See Footnote 5	Uncertainties stated as percent of reading plus floor specification
(0.1 to 10) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz	0.46 % + 0.024 µA 0.18 % + 0.024 µA 0.07 % + 0.024 µA 0.036 % + 0.024 µA		
(10 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz	0.46 % + 0.085 µA 0.18 % + 0.085 µA 0.07 % + 0.085 µA 0.036 % + 0.085 µA		
(0.1 to 1) A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz	0.46 % + 0.82 µA 0.19 % + 0.82 µA 0.093 % + 0.82 µA 0.12 % + 0.82 µA		
100 mA to 20 A	DC to 5 kHz	0.036 % + 0.14 %*F*		with Fluke Y5020 shunt; *F* is the frequency in kHz.

Parameter/Range	Frequency	Best Uncertainty[2, 3, 6] (±)		Comments
		Laboratory	On-Site	
AC Resistance – Generate, Fixed Values				
0.1 Ω 1 Ω 10 Ω (0.1, 1, 10, 100) kΩ	DC to 1 MHz	1.1 % 0.12 % 0.11 % 0.032 %	Not Available	16074A AC resistance standards
Capacitance – Generate, Fixed Values				
(1, 10,100) pF and 1 nF	1 kHz to 13 MHz	0.036 %	Not available	Standard capacitors
(10, 100) nF and 1 μF	120 Hz to 1 kHz	0.037 %		
100 pF to 1.1 μF	1 kHz	0.01 % + 0.05 pF	See Footnote 5	GenRad 1423-A capacitance decade
Capacitance – Measure				
1 pF to 1100 μF	20 Hz to 20 kHz	1.2 % + 1 pF	See Footnote 5	GenRad 1650-B bridge
Capacitance – Measure				
1 pF	500 Hz to 5 kHz (5 to 100) kHz	1.0 % 1.0 %	See Footnote 5	Fluke PM6304C
10 pF	(150 to 500) Hz 500 to 5 kHz (5 to 20) kHz (20 to 100) kHz	10 % 1.0 % 0.10 % 0.40 %		
100 pF	(50 to 250) Hz 250 Hz to 1 kHz (1 to 20) kHz (20 to 100) kHz	10 % 1.0 % 0.10 % 0.40 %		

Parameter/Range	Frequency	Best Uncertainty[2, 3, 6] (±)		Comments
		Laboratory	On-Site	
Capacitance – Measure (cont)				
1 nF	(50 to 250) Hz 250 Hz to 20 kHz (20 to 100) kHz	1.0 % 0.10 % 0.40 %	See Footnote 5	Fluke PM6304C
10 nF	(50 to 500) Hz 500 Hz to 2 kHz (2 to 20) kHz (20 to 100) kHz	0.10 % 0.05 % 0.10 % 0.40 %		
100 nF	(50 to 150) Hz 150 Hz to 2 kHz (2 to 20) kHz (20 to 100) kHz	0.10 % 0.05 % 0.10 % 0.40 %		
1 µF	50 Hz to 2 kHz (2 to 20) kHz (20 to 100) kHz	0.05 % 0.10 % 0.40 %		
10 µF	(50 to 1500) Hz (1.5 to 15) kHz (15 to 50) kHz (50 to 100) kHz	0.05 % 0.10 % 1.0 % 10 %		
100 µF	(50 to 1500) Hz (1.5 to 15) kHz (15 to 50) kHz	0.10 % 1.0 % 10 %		
(100 to 200) µF (200 to 300) µF (0.33 to 110) mF	Direct Current Direct Current Direct Current	0.065 % 0.048 % 0.042 %		Time-charge method with Fluke 5720A and HP 3458A

Parameter/Range	Frequency	Best Uncertainty[2, 3, 6] (±)		Comments
		Laboratory	On-Site	
Inductance – Measure				
1 µH	500 Hz to 1.5 kHz (50 to 100) kHz	10 % 1.0 %	See Footnote 5	Fluke PM6304C
10 µH	(250 to 500) Hz 500 Hz to 20 kHz (20 to 100) kHz	10 % 1.0 % 0.40 %		
100 µH	(75 to 250) Hz (250 to 1500) Hz (1.5 to 20) kHz (20 to 100) kHz	10 % 1.0 % 0.10 % 0.40 %		
1 mH	(50 to 75) Hz (75 to 250) Hz 250 Hz to 20 kHz (20 to 100) kHz	10 % 1.0 % 0.10 % 0.40 %		
10 mH	(50 to 75) Hz (75 to 250) Hz 250 Hz to 2 kHz (2 to 20) kHz (20 to 100) kHz	10 % 1.0 % 0.05 % 0.10 % 0.40 %		
100 mH	(50 to 75) Hz 75 Hz to 2 kHz (2 to 20) kHz (20 to 100) kHz	0.10 % 0.05 % 0.10 % 0.40 %		
1 H	50 Hz to 2 kHz (2 to 20) kHz (20 to 100) kHz	0.05 % 0.10 % 0.40 %		
10 H	(50 to 250) Hz 250 Hz to 20 kHz (20 to 100) kHz	0.05 % 0.10 % 1.0 %		
Inductance – Generate, Fixed Values				
100 µH 10 mH 100 mH 10 H	400 Hz, 1 kHz	0.13 % 0.06 % + 0.02 H 0.04 % 0.06 % + 0.02 H	See Footnote 5	Standard inductors

Parameter/Equipment	Range	Best Uncertainty[2, 3] (±)		Comments
		Laboratory	On-Site	
Electrical Calibration of Thermocouples – Generate and Measure				
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.51 °C 0.39 °C 0.35 °C 0.38 °C	See Footnote 5	Fluke 5520A
Type C	(0 to 150) °C (150 to 650) °C (650 to 1000) °C (1000 to 1800) °C (1800 to 2316) °C	0.35 °C 0.3 °C 0.36 °C 0.58 °C 0.97 °C		
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.5 °C 0.16 °C 0.14 °C 0.16 °C 0.21 °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 0.4 °C		
Type L	(-200 to -100) °C (-100 to 800) °C (800 to 900) °C	0.43 °C 0.3 °C 0.2 °C		
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.46 °C 0.25 °C 0.22 °C 0.21 °C 0.31 °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 0.4 °C		
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		

Parameter/Equipment	Range	Best Uncertainty[2, 3] (±)		Comments
		Laboratory	On-Site	
Electrical Calibration of Thermocouples – Generate and Measure (cont)				
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	See Footnote 5	Fluke 5520A
Type U	(-200 to 0) °C (0 to 600) °C	0.65 °C 0.31 °C		
Electrical Calibration of RTDs – Generate				
Pt 385, 100 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.04 °C 0.05 °C 0.07 °C 0.08 °C 0.09 °C 0.10 °C 0.21 °C	See Footnote 5	Fluke 5520A; 4-wire compensation
Pt 3926, 100 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.04 °C 0.05 °C 0.07 °C 0.08 °C 0.09 °C 0.10 °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 0.04 °C 0.05 °C 0.06 °C 0.06 °C 0.07 °C 0.08 °C 0.08 °C 0.21 °C		
Pt 385, 200 Ω	(-200 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	0.03 °C 0.03 °C 0.04 °C 0.04 °C 0.11 °C 0.12 °C 0.12 °C 0.14 °C		

Parameter/Equipment	Range	Best Uncertainty[2, 3] (±)		Comments
		Laboratory	On-Site	
Electrical Calibration of RTDs – Generate (cont)				
Pt 385, 500 Ω	(-200 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	0.03 °C 0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.07 °C 0.08 °C 0.09 °C	See Footnote 5	Fluke 5520A; 4-wire compensation
Pt 385, 1000 Ω	(-200 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	0.03 °C 0.03 °C 0.03 °C 0.04 °C 0.05 °C 0.05 °C 0.06 °C 0.22 °C		
Ni 120, 120 Ω	(-80 to 0) °C (0 to 100) °C (100 to 300) °C	0.06 °C 0.07 °C 0.13 °C		
Cu 427, 10 Ω	(-100 to 260) °C	0.30 °C		
Thermocouple – Indicating Systems & Measure	E, J, K, T, R, S	0.5 m°C/°C + 0.03 °C 0.5 m°C/°C + 0.03 °C	See Footnote 5	HP 3458A w/ DCV source
Phase Angle	(1 to 1000) Hz 1001 Hz to 6.25 kHz (6.26 to 50) kHz (50.01 to 100) kHz	0.006 ° + 0.05*R* 0.012 ° + 0.1*R* 0.029 ° + 0.25*R* 0.058 ° + 0.5*R*	See Footnote 5	Clark Hess model 5000; *R* is the ratio between the REF and VAR output amplitudes.
pH Measuring Equipment	Up to 14 units	0.0006 units + 0.6	See Footnote 5	Fluke 5500A
Distortion	20 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.012 % 0.037 % 0.065 %	See Footnote 5	HP 8903A

Parameter/Equipment	Range	Best Uncertainty[2, 3, 4, 6] (±)		Comments
		Laboratory	On-Site	
Oscilloscopes –				
Risetime - Generate	Single Sided	180 ps +/-100 ps	See Footnote 5	Fluke 5820A
Risetime - Measure	Up to 50 GHz	<10 ps +/-3 ps	See Footnote 5	Tektronix TDS-8200 with 80E01
Bandwidth	50 kHz to 2.1 GHz	1.2 %	See Footnote 5	Fluke 5820A
	(2.1 to 4.2) GHz (4.2 to 18) GHz (18 to 26.5) GHz	0.24 dB 0.71 dB 0.47 dB		HP 8340A w/: 8482A, 11667A 8481A, 11667A 8485A, 11667B

VI. Thermodynamics

Parameter/Equipment	Range	Best Uncertainty[2, 3, 4, 6] (±)		Comments
		Laboratory	On-Site	
Temperature – Measure	(-197 to 660) °C	0.0036 % + 0.012 °C	See Footnote 5	Hart 5628 with 1502
Temperature Measuring Equipment	-80 °C -45 °C to 140 °C 140 °C to 660 °C	0.15 °C 0.0036 % + 0.014 °C 0.0036 % + 0.044 °C	See Footnote 5	Hart 5628 with 1502 with 9107 with 9127
Infrared Measuring Equipment	(-30 to 150) °C	0.5 °C + 0.6*R*	See Footnote 5	Hart 9133
Relative Humidity Measuring Equipment	15 % to 98 %	1.2 % + 0.6*R*	See Footnote 5	Thunder 5A-1MP psychrometer

VII. Chemical

Parameter/Equipment	Range	Best Uncertainty[2, 3, 4] (±)		Comments
		Laboratory	On-Site	
pH Measuring Equipment	(4, 7, 10) units	0.012 units + 0.6*R*	See Footnote 5	Buffer solutions
Electrolytic Conductivity Measuring Equipment	10.2 µS/cm 995 µS/cm 9740 µS/cm	0.52 µS/cm + 0.6*R* 24 µS/cm + 0.6*R* 230 µS/cm + 0.6*R*	See Footnote 5	Conductivity solutions

VIII. Fluid Quantities

Parameter/Equipment	Range	Best Uncertainty[2, 3, 4, 6] (±)		Comments
		Laboratory	On-Site	
Hydrometers	(0.7 to 1.2) sp. gr. (1.2 to 2.0) sp. gr.	0.0007 sp. gr. 0.0012 sp. gr.	See Footnote 5	ASTM E126; By comparison using reference hydrometer
Volume	(0 to 4000) mL (4 to 30) L	0.05 mL + 0.6*R* 0.37 mL + 0.6*R*	See Footnote 5	Gravimetric/ electronic balances
Viscosity – Ford, Dip and Other Viscosity Cups	Cup Nos. 1 through 5	2.8 %	See Footnote 5	ASTM D1200-94, D4212-93, ISO-2431

[1] This laboratory offers commercial calibration service and field calibration service (where noted.)

[2] "Best Uncertainty" 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 of nearly ideal measuring equipment. Best uncertainties represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of $k = 2$. The best uncertainty of a specific calibration performed by the laboratory may be greater than the best uncertainty due to the behavior of the customer's device, to the environment (if the calibration is performed in the field) and to influences from the circumstances of the specific calibration. The usual allowance for the uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the calibration uncertainty being larger than the BMC.

[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 uncertainties achievable on a customer's site can normally be expected to be larger than the Best Measurement Capabilities (BMC) that the accredited laboratory has been assigned as Best Uncertainty 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 uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the calibration uncertainty being larger than the BMC.

[4] In the statement of best uncertainty, 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; R is the numerical value of the resolution of the device in its respective units.

[5] The best uncertainty stated for calibrations performed in the laboratory is applicable for the calibrations performed on-site.

[6] In the statement of best uncertainty, uncertainties stated as percentages are percentages of reading unless otherwise indicated.