SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017
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CALIBRATION

Valid To: December 31, 2025 Certificate Number: 2357.02

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted at the location listed above to perform the following calibrations[1, 5]:

I. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
DC Voltage – Generate	0 V (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 1000) V (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	0.60 µV 6.0 µV/V + 0.60 µV 6.0 µV/V + 0.60 µV 4.0 µV/V + 3.0 µV 4.0 µV/V + 2.0 µV 5.0 µV/V + 40 µV 8.0 µV/V + 300 µV 0.6 µV/V + 77 nV 0.6 µV/V + 89 nV 1.0 µV/V 0.9 µV/V + 12 µV	Short Fluke 57X0A Fluke 732B, 752A, Fluke 8508A
DC Voltage – Measure	0 V (0 to 0.1) V (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1100) V 0 V 0.329 V 1 V 3.29 V 10 V (32.9 to 50) V 329 V 334 V	0.70 µV 5.0 µV/V + 0.70 µV 6.0 µV/V + 0.30 µV 4.0 µV/V + 10 µV 7.0 µV/V + 40 µV 20 µV/V 0.31 µV 1.4 µV 3.5 µV 14 µV 14 µV 50 µV 0.73 mV 0.84 mV	Short HP 3458A, OPT 002 HP 3458A, OPT 002 HP 3458A, OPT 002 w/ 752A

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
DC Voltage – Measure (cont)	900 V 1000 V 0.1 V 1 V 10 V 100 V 1000 V	0.83 mV 0.86 mV 1.2 µV 2.6 µV 16 µV 250 µV 2.6 mV	HP 3458A, OPT 002 w/ 752A HP 3458A, OPT 002 w/ 752A, 732B
DC Voltage – Measure[3]	0.02 V 0.1 V 0.2 V 1 V 2 V 10 V 20 V 100 V 200 V	37 µV 34 µV 34 µV 44 µV 58 µV 0.3 mV 1.1 mV 3.4 mV 12 mV	Keithley DMM7510
Thermocouple Simulation – Measure 0 °C 100 °C 1000 °C 10 000 °C	 0 mV 1 mV 10 mV 100 mV	 0.43 µV 0.45 µV 0.44 µV 0.72 µV	 HP 3458A, OPT 002
Thermocouple Simulation – Generate 0 mV 100 mV	 0 °C 10 000 °C	 0.11 °C 0.29 °C	 Fluke 55XXA
DC Current – Generate	0 pA (0.2 to 2) pA (2 to 20) pA (20 to 200) pA (0.2 to 2) nA (2 to 20) nA (20 to 200) nA (1 to 220) µA (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A	0.9 fA 0.08 % + 0.9 fA 0.1 % + 0.6 fA 0.06 % + 8 fA 0.06 % + 4 fA 0.02 % + 0.8 pA 0.02 % + 0.4 fA 40 µA/A + 6.0 nA 30 µA/A + 6.0 nA 30 µA/A + 40 nA 70 µA/A + 0.30 µA 80 µA/A + 10 µA	Short / open Fluke 57X0A Keithley 5156 Fluke 57X0A

Parameter/Equipment	Range	CMC[2, 4, 7] (±)	Comments
DC Current – Generate (cont)	(2.2 to 11) A (11 to 50) A (110 to 500) A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A (1 to 10) A	0.040 % + 0.50 mA 1.7 % 0.85 % 3.6 µA/A 5.9 µA/A 13 µA/A 39 µA/A 60 µA/A	Fluke 57X0A/5725A 5500A/COIL Fluke 8508A, Fluke 742A
DC Current – Measure	0 pA (0 to 20) pA (20 to 200) pA (0.2 to 2) nA (2 to 20) nA (20 to 200) nA (0 to 100) nA (0.1 to 1) µA (1 to 10) µA (10 to 100) µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A (1 to 2) A (2 to 11) A (0 to 1) pA (5 to 10) pA (50 to 100) pA (0.5 to 1) nA (5 to 10) nA (50 to 100) nA (0.5 to 1) µA (5 to 10) µA (50 to 100) µA (0.5 to 1) mA (5 to 10) mA (50 to 100) mA 190 µA 329 µA 1.9 mA 3.29 mA 19 mA 32.9 mA	10 fA 0.96 % + 10 fA 1 % + 4 fA 0.13 % + 2 pA 0.2 % + 0.3 pA 0.2 % + 20 fA 3.3 % + 50 pA 0.33 % + 30 pA 0.030 % + 30 pA 40 µA/A + 0.8 nA 40 µA/A + 5 nA 40 µA/A + 50 nA 50 µA/A + 0.6 µA 0.010 % + 10 µA 0.020 % + 30 µA 0.040 % + 0.40 mA 0.25 % + 1.0 fA 0.12 % + 0.1 fA 0.03 % + 0.4 fA 0.03 % + 2 fA 0.01 % + 30 fA 0.01 % + 0.4 pA 0.02 % + 5 pA 0.01 % + 50 pA 0.04 % + 8 nA 0.04 % + 50 nA 0.05 % + 0.5 µA 0.06 % + 5 µA 3.0 nA 3.6 nA 30 nA 35 nA 0.31 µA 0.39 µA	Short / open Keithley 6514 HP 3458A Fluke 8508A Keithley 2002 Keithley 7177 HP 3458A, OPT 002 w/ Fluke 742A-1k w/ Fluke 742A-100 w/ Fluke 742A-10

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
DC Current – Measure (cont)	190 mA 329 mA 1.09 A 2.99 A 10.9 A 20 A 100 µA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1A	3.1 µA 4.0 µA 15 µA 44 µA 390 µA 790 µA 6.7 µA/A 10 µA/A 12 µA/A 12 µA/A	HP 3458A, OPT 002 w/ Fluke 742A-1 w/ Guildline 9230 w/ Fluke Y5020 HP3458A, OPT 002 w/ 742A-1k, w/ 742A-100, w/ 742A-10, w/ 742A-1, w/ Guildline 9230
DC Current – Measure[3]	0.1 nA 0.5 nA 1 nA 5 nA 10 nA 50 nA 100 nA 0.5 µA 1 µA 5 µA 10 µA 50 µA 100 µA 0.5 mA 1 mA 5 mA 10 mA 50 mA 100 mA 0.5 A 1 A	0.31 pA 0.86 pA 1.3 pA 5.8 pA 8.3 pA 34 pA 68 pA 86 pA 0.12 nA 3.0 nA 2.4 nA 7.2 nA 13 nA 59 nA 0.11 µA 0.58 µA 0.97 µA 5.5 µA 17 µA 190 µA 0.20 mA	Keithley DMM7510 Keithley 5880-SRU
DC Resistance – Generate, Fixed Points	1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	90 µΩ 0.17 mΩ 0.23 mΩ 0.43 mΩ 1.1 mΩ 2.0 mΩ 9.3 mΩ 0.017 Ω 0.093 Ω 0.17 Ω 1.1 Ω 2.1 Ω 19 Ω 38 Ω 0.44 kΩ 0.95 kΩ 12 kΩ	Fluke 57X0A

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
DC Resistance – Generate	(0 to 10.9999) Ω (11 to 32.9999) Ω (33 to 109.9999) Ω (110 to 329.9999) Ω (0.33 to 32.099 999) kΩ (1.1 to 3.299 999) kΩ (3.3 to 10.999 99) kΩ (11 to 32.999 99) kΩ (33 to 109.9999) kΩ (110 to 329.9999) kΩ (0.33 to 1.099 999) MΩ (1.1 to 3.299 999) MΩ (3.3 to 10.999 99) MΩ (11 to 32.999 99) MΩ (33 to 109.9999) MΩ (110 to 329.9999) MΩ (330 to 1100) MΩ (1 to 10) Ω (10 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 (10 to 100) MΩ (0.1 to 1) GΩ	31 μΩ/Ω + 0.78 mΩ 24 μΩ/Ω + 1.2 mΩ 22 μΩ/Ω + 1.1 mΩ 22 μΩ/Ω + 1.5 mΩ 22 μΩ/Ω + 1.6 mΩ 23 μΩ/Ω + 15 mΩ 23 μΩ/Ω + 16 mΩ 22 μΩ/Ω + 0.16 Ω 23 μΩ/Ω + 0.14 Ω 27 μΩ/Ω + 1.4 Ω 25 μΩ/Ω + 2.0 Ω 50 μΩ/Ω + 21 Ω 0.1 mΩ/Ω + 41 Ω 0.2 mΩ/Ω + 1.9 kΩ 0.4 mΩ/Ω + 2.4 kΩ 2.3 mΩ/Ω + 77 kΩ 12 mΩ/Ω + 0.43 MΩ 0.89 μΩ/Ω + 1.1 μΩ 0.54 μΩ/Ω + 4.6 μΩ 1.0 μΩ/Ω 1.0 μΩ/Ω 2.1 μΩ/Ω 2.4 μΩ/Ω 6.7 μΩ/Ω 14 μΩ/Ω 0.12 mΩ/Ω	Fluke 5722A Fluke 742A Fluke 8508A-7000k
DC Resistance – Measure	(0.1 to 10) Ω (10 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 (10 to 100) MΩ	20 μΩ/Ω + 0.060 mΩ 10 μΩ/Ω + 0.60 mΩ 10 μΩ/Ω + 0.60 mΩ 10 μΩ/Ω + 5.6 mΩ 10 μΩ/Ω + 0.070 Ω 20 μΩ/Ω + 2.3 Ω 60 μΩ/Ω + 120 Ω 0.060 % + 1.1 kΩ	HP 3458A

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
DC Resistance – Measure (cont)			
Fixed Points	0 Ω	53 µΩ	4 wire short
	0 Ω	53 µΩ	HP 3458A
	2 Ω	82 µΩ	
	10.9 Ω	0.61 mΩ	
	11.9 Ω	0.62 mΩ	
	19 Ω	0.86 mΩ	
	30 Ω	0.95 mΩ	
	33 Ω	0.97 mΩ	
	109 Ω	2.1 mΩ	
	119 Ω	5.3 mΩ	
	190 Ω	5.6 mΩ	
	300 Ω	6 mΩ	
	330 Ω	6 mΩ	
	1.09 kΩ	0.015 Ω	
	1.19 kΩ	0.015 Ω	
	1.9 kΩ	0.025 Ω	
	3 kΩ	0.032 Ω	
	3.3 kΩ	0.077 Ω	
	10.9 kΩ	0.15 Ω	
	11.9 kΩ	0.53 Ω	
	19 kΩ	0.55 Ω	
	30 kΩ	0.59 Ω	
	33 kΩ	0.92 Ω	
	109 kΩ	1.5 Ω	
	119 kΩ	1.0 Ω	
	190 kΩ	1.1 Ω	
	300 kΩ	0.93 Ω	
	330 kΩ	0.92 Ω	
	1.09 MΩ	3 Ω	
	1.19 MΩ	14 Ω	
	1.9 MΩ	35 Ω	
	3 MΩ	23 Ω	HP 3458 w/ 742A-1M
	3.3 MΩ	0.15 kΩ	
	10.9 MΩ	0.17 kΩ	
	11.9 MΩ	0.13 kΩ	
	19 MΩ	1.3 kΩ	
	30 MΩ	0.52 kΩ	
	33 MΩ	0.53 kΩ	w/ 742A-10M
	109 MΩ	3.3 kΩ	HP 3458A w/ Guildline 9334A-100M
	119 MΩ	7.1 kΩ	
	290 MΩ	21 kΩ	
	400 MΩ	0.31 MΩ	
	640 MΩ	1.9 MΩ	
	1090 MΩ	0.34 MΩ	

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
DC Resistance – Measure (cont)	(1 to 1.9) Ω (1.9 to 10) Ω (10 to 19) Ω (19 to 100) Ω (100 to 190) Ω 190 Ω to 1 kΩ (1 to 1.9) kΩ (1.9 to 10) kΩ (10 to 19) kΩ (19 to 100) kΩ (100 to 190) kΩ 190 kΩ to 1 MΩ (1 to 1.9) MΩ (1.9 to 10) MΩ (10 to 19) MΩ (19 to 100) MΩ	21 µΩ 1.3 µΩ/Ω + 16 µΩ 12 µΩ/Ω + 2 µΩ 0.74 µΩ/Ω + 220 µΩ 5.3 µΩ/Ω 0.37 µΩ/Ω + 930 µΩ 5.3 µΩ/Ω 0.12 µΩ/Ω + 9.8 mΩ 10 µΩ/Ω 0.10 µΩ/Ω + 0.19 Ω 12 µΩ/Ω + 0.020 Ω 0.60 µΩ/Ω + 2.2 Ω 13 µΩ/Ω + 0.3 Ω 80 µΩ/Ω 56 µΩ/Ω + 240 Ω 90 µΩ/Ω	Fluke 8508A w/ 742A w/ Guildline 9334A-100M

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Generate			
(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	0.010 % + 5.0 µV 0.020 % + 4.0 µV 60 µV/V + 4.0 µV 0.020 % + 4.0 µV 0.030 % + 6.0 µV 0.11 % + 10 µV 0.11 % + 20 µV 0.22 % + 20 µV	Fluke 57X0A
(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	0.060 % + 4.0 µV 0.040 % + 4.0 µV 0.030 % + 4.0 µV 0.020 % + 4.0 µV 0.080 % + 5.0 µV 0.14 % + 10 µV 0.14 % + 20 µV 0.27 % + 20 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	0.030 % + 10 µV 0.020 % + 10 µV 90 µV/V + 7.0 µV 0.020 % + 7.0 µV 0.050 % + 20 µV 0.090 % + 20 µV 0.13 % + 30 µV 0.26 % + 50 µV	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Generate (cont)			
220 mV 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	0.030 % + 40 µV 0.020 % + 40 µV 90 µV/V + 20 µV 70 µV/V + 10 µV 0.010 % + 30 µV 0.040 % + 80 µV 0.10 % + 200 µV 0.15 % + 400 µV	Fluke 57X0A
(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	0.030 % + 0.40 mV 0.020 % + 0.40 mV 90 µV/V + 0.20 mV 70 µV/V + 90 µV 0.010 % + 0.20 mV 0.030 % + 0.60 mV 0.090 % + 0.90 mV 0.14 % + 3.1 mV	
(22 to 220) 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	0.030 % + 3.5 mV 0.020 % + 3.8 mV 90 µV/V + 1.5 mV 80 µV/V + 0.90 mV 0.14 % + 1.6 mV 0.090 % + 15 mV	
(220 to 700) V	(15 to 50) Hz 50 Hz to 1 kHz	90 µV/V + 1.6 mV 80 µV/V	
(700 1100) V	40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	0.010 % + 0.30 mV 0.020 % + 3.3 mV 0.060 % + 10 mV	Fluke 57X0A/5725A
(0.1 to 1) V	(20 to 55) Hz 55 Hz to 1 kHz (1 to 3) kHz (3 to 10) kHz (10 to 30) kHz (30 to 60) kHz (60 to 100) kHz	29 µV/V + 1 µV 23 µV/V + 2 µV 24 µV/V + 1 µV 30 µV/V 36 µV/V + 4 µV 58 µV/V + 10 µV 74 µV/V + 9 µV	Fluke 792A, Fluke 5790A/B, Fluke 5730A
(1 to 10) V	(20 to 55) Hz 55 Hz to 1 kHz (1 to 3) kHz (3 to 10) kHz (10 to 30) kHz (30 to 60) kHz (60 to 100) kHz (100 to 500) kHz 500 kHz to 1 MHz	31 µV/V 26 µV/V 31 µV/V 30 µV/V 57 µV/V 0.10 mV/V 0.17 mV/V 2.9 mV/V 4.5 mV/V	Fluke 792A, Fluke 5790A/B, Fluke 5730A

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Generate (cont)			
(10 to 100) V	(20 to 55) Hz 55 Hz to 1 kHz (1 to 3) kHz (3 to 10) kHz (10 to 30) kHz (30 to 60) kHz (60 to 100) kHz	39 µV/V 25 µV/V + 11 µV 29 µV/V + 11 µV 30 µV/V 72 µV 0.11 mV/V 0.10 mV/V	Fluke 792A, Fluke 5790A/B, Fluke 5730A
(100 to 500) V	50 Hz to 1 kHz (1 to 3) kHz (3 to 10) kHz (10 to 30) kHz	39 µV/V 38 µV/V 43 µV/V 73 µV/V	
(500 to 1000) V	(1 to 30) kHz	2 µV/V + 17 mV	
AC Voltage – Generate Squarewave (V_{p-p})			
(24 to 26) mV_{p-p} (72 to 78) mV_{p-p} (2.4 to 2.6) V_{p-p} (4.8 to 5.2) V_{p-p}	1 kHz	0.067 mV 0.095 mV 2.5 mV 7.6 mV	Wavetek 9500, Fluke 9500/B w/ 9530
AC Voltage – Measure			
220 µV 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 % + 4.0 µV 0.020 % + 3.0 µV 0.030 % + 3.0 µV 0.10 % + 3.0 µV 0.60 % + 2.0 µV 4.6 % + 3.0 µV	HP 3458A
(10 to 100) 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	70 µV/V + 50 µV 0.010 % + 9.0 µV 0.010 % + 9.0 µV 0.030 % + 8.0 µV 0.090 % + 5.0 µV 0.35 % + 10 µV 1.2 % + 30 µV	
(0.1 to 1) 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	70 µV/V + 60 µV 70 µV/V + 40 µV 0.020 % + 40 µV 0.030 % + 40 µV 0.090 % + 30 µV 0.35 % + 100 µV 1.2 % + 300 µV	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Measure (cont)			
(1 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	70 µV/V + 0.70 mV 60 µV/V + 0.60 mV 0.010 % + 0.60 mV 0.030 % + 0.50 mV 0.090 % + 0.40 mV 0.35 % + 1.3 mV 1.2 % + 5.6 mV	HP 3458A
(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	0.020 % + 5.7 mV 0.020 % + 3.8 mV 0.020 % + 3.8 mV 0.040 % + 3.4 mV 0.14 % + 3.3 mV	Fluke 8508A
(100 to 700) V	40 Hz to 1 kHz	0.050 % + 30 mV	
(700 to 1000) V	40 Hz to 10 kHz (10 to 30) kHz	0.030 % + 24 mV 0.020 % + 57 mV	
3 mV 30 mV	(50 to 60) Hz 10 Hz 50 Hz 60 Hz to 20 kHz 50 kHz 100 kHz 450 kHz	2 µV 9.1 µV 3.7 µV 3.6 µV 6.1 µV 0.11 mV 30 µV	Fluke 5790B
33 mV 300 mV	1 kHz 10 Hz 50 Hz 60 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 500 kHz	3.9 µV 68 µV 20 µV 12 µV 18 µV 19 µV 12 µV 18 µV 28 µV 0.11 mV	
0.33 V 3 V	1 kHz 10 Hz 50 Hz 60 Hz 1 kHz 10 kHz	18 µV 0.93 mV 0.14 mV 0.12 mV 0.10 mV 0.19 mV	
3 V	20 kHz 50 kHz 100 kHz 450 kHz	85 µV 0.15 mV 0.25 mV 1.2 mV	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Measure (cont)			
3.3 V	1 kHz	0.35 mV	Fluke 5790B
30 V	10 Hz	6.1 mV	
	50 Hz	1.0 mV	
	60 Hz	1.1 mV	
	(1 to 10) kHz	1.0 mV	
	20 kHz	1.1 mV	
	50 kHz	1.8 mV	
	90 kHz	2.9 mV	
33 V	1 kHz	2.5 mV	
300 V	50 Hz	14 mV	
	60 Hz	15 mV	
	(1 to 18) kHz	14 mV	
	50 kHz	40 mV	
	80 kHz	0.15 V	
330 V	1 kHz	16 mV	
1000 V	(50 to 60) Hz	44 mV	
	1 kHz	48 mV	
	5 kHz	43 mV	
	8 kHz	44 mV	
10 mV	50 Hz	12 µV	
	60 Hz	2.2 µV	
	1 kHz	2.9 µV	
	5 kHz	3.4 µV	
300 mV	10 kHz	2.8 µV	
	30 kHz	2.6 µV	
	10 Hz	64 µV	
	45 Hz	12 µV	
	50 Hz	15 µV	
	60 Hz	12 µV	
	1 kHz	18 µV	
	5 kHz	12 µV	
	10 kHz	19 µV	
	30 kHz	18 µV	
3 V	10 Hz	0.93 mV	
	45 Hz	0.11 mV	
	50 Hz	0.15 mV	
	60 Hz	0.14 mV	
	1 kHz	0.11 mV	
	5 kHz	0.10 mV	
	10 kHz	0.20 mV	
	30 kHz	0.16 mV	
5 V	10 Hz	50 mV	
	45 Hz	0.35 mV	
	50 Hz	0.31 mV	
	60 Hz	0.28 mV	
	1 kHz	0.22 mV	
	5 kHz	0.19 mV	
	10 kHz	1.1 mV	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Measure (cont)			
(2 to 20) mV	10 Hz 50 Hz 60 Hz 400 Hz to 20kHz 50 kHz 100 kHz 300 kHz 1 MHz	120 µV/V + 3.5 µV 61 µV/V + 1.7 µV 67 µV/V + 1.6 µV 61 µV/V + 1.6 µV 120 µV/V + 2.6 µV 180 µV/V + 3.5 µV 520 µV/V + 5.7 µV 1200 µV/V + 10 µV	Fluke 5790B
(20 to 200) mV	10 Hz 50 Hz 60 Hz 400 Hz 1 kHz 20 kHz 50 kHz 100 kHz 300 kHz 1 MHz	170 µV/V + 2.4 µV 45 µV/V + 2.0 µV 31 µV/V + 2.3 µV 27 µV/V + 2.4 µV 26 µV/V + 2.4 µV 27 µV/V + 2.3 µV 45 µV/V + 4.0 µV 120 µV/V + 4.6 µV 160 µV/V + 13 µV 760 µV/V + 19 µV	
(0.2 to 2) V	10 Hz 50 Hz 60 Hz 400 Hz 1 kHz 20 kHz 50 kHz 100 kHz 300 kHz 1 MHz	800 µV/V 41 µV/V + 2.9 µV 21 µV/V + 4.2 µV 19 µV/V + 4.0 µV 17 µV/V + 5.0 µV 18 µV/V + 4.1 µV 34 µV/V + 6.2 µV 51 µV/V + 18 µV 120 µV/V + 21 µV 740 µV/V + 22 µV	
(2 to 20) V	10 Hz 50 Hz 60 Hz 400 Hz 1 kHz 20 kHz 50 kHz 100 kHz 300 kHz 1 MHz	800 µV/V 22 µV/V + 40 µV 32 µV/V 24 µV/V 24 µV/V 23 µV/V 39 µV/V 65 µV/V 150 µV/V 950 µV/V	
(20 to 200) V	10 Hz 50 Hz 60 Hz 400 Hz 1 kHz 20 kHz 50 kHz 100 kHz	1100 µV/V + 14 000 µV 41 µV/V 34 µV/V 27 µV/V 27 µV/V 23 µV/V 55 µV/V 80 µV/V	
(200 to 1000) V	50 Hz 60 Hz 400 Hz 1 kHz	39 µV/V + 380 µV 57 µV/V 34 µV/V 34 µV/V	

Parameter/Range	Frequency	CMC[2, 4, 7] (±)	Comments
AC Current – Generate			
(0 to 0.22) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.020 % + 20 nA 0.020 % + 20 nA 0.010 % + 20 nA 0.020 % + 20 nA 1.0 % + 60 nA	Fluke 57X0A
(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	0.020 % + 40 nA 0.020 % + 40 nA 0.020 % + 30 nA 0.020 % + 100 nA 0.10 % + 600 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	0.020 % + 200 nA 0.020 % + 200 nA 0.020 % + 100 nA 0.020 % + 300 nA 0.090 % + 3.0 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	0.020 % + 2.0 µA 0.020 % + 4.0 µA 0.020 % + 3.0 µA 0.020 % + 3.0 µA 0.10 % + 10 µA	
220 mA to 2.2 A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.030 % + 30 µA 0.050 % + 80 µA 0.72 % + 0.20 mA	
(2.2 to 11) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.05 % + 0.20 mA 0.10 % + 0.30 mA 0.36 % + 1.3 mA	Fluke 57X0A/5725A
(11 to 500) A	(45 to 65) Hz	1.5 %	Fluke 5500A/COIL
(0.1 to 1) mA	(0.3 to 1) kHz (1 to 3) kHz (3 to 5) kHz (5 to 10) kHz	0.12 mA/A + 5.6 nA 0.13 mA/A + 0.11 µA 0.13 mA/A 0.12 mA/A	Metal film register Fluke 5790A/B Fluke 5730A
(1 to 10) mA	(0.3 to 1) kHz (1 to 3) kHz (3 to 5) kHz (5 to 10) kHz	18 µA/A + 0.11 µA 18 µA/A + 0.11 µA 20 µA/A + 0.11 µA 20 µA/A + 0.11 µA	Shunt: A40B-10 mA A40B-1 A A40B-20 A
(10 to 100) mA	(0.3 to 1) kHz (1 to 3) kHz (3 to 5) kHz (5 to 10) kHz	39 µA/A 40 µA/A 41 µA/A 41 µA/A	
(0.1 to 1) A	(0.3 to 1) kHz (1 to 3) kHz (3 to 5) kHz (5 to 10) kHz	60 µA/A 60 µA/A 42 µA/A 42 µA/A	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Current – Generate (cont)			
(1 to 10) A	(0.3 to 1) kHz (1 to 3) kHz (3 to 5) kHz (5 to 10) kHz	82 µA/A 0.12 mA/A 0.21 mA/A 0.64 mA/A	Shunt: A40B-10 mA A40B-1 A A40B-20 A
AC Current – Measure			
(10 to 100) µA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 1) kHz	0.46 % + 0.040 µA 0.17 % + 0.040 µA 0.070 % + 0.040 µA 0.070 % + 0.040 µA	HP 3458A
(0.1 to 1) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz	0.46 % + 0.30 µA 0.17 % + 0.30 µA 0.060 % + 0.40 µA 0.030 % + 0.40 µA	
(1 to 10) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz	0.46 % + 3.0 µA 0.16 % + 4.0 µA 0.050 % + 5.0 µA 0.020 % + 5.0 µA	
(10 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz	0.46 % + 30 µA 0.16 % + 40 µA 0.060 % + 40 µA 0.020 % + 40 µA	
(0.1 to 1) A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz	0.45 % + 400 µA 0.15 % + 700 µA 0.060 % + 800 µA 0.090 % + 700 µA	
(1 to 2) A	10 Hz to 2 kHz (2 to 10) kHz	0.060 % + 0.20 mA 0.080 % + 0.20 mA	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Current – Measure (cont)			
(2 to 11) A	10 Hz to 2 kHz (2 to 10) kHz	0.080 % + 2.0 mA 0.26 % + 2.0 mA	Fluke 8508A
33 µA	(1 to 10) kHz	0.036 µA	Fluke 5522A, 5790B w/ 1 kΩ metal film resistor
329 µA	10 Hz 45 Hz 50 Hz 60 Hz to 30 kHz	0.13 µA 0.11 µA 0.16 µA 0.11 µA	
0.33 mA	(1 to 5) kHz	0.13 µA	
3.29 mA	10 Hz 45 Hz 50 Hz 60 Hz to 10 kHz 30 kHz	0.97 µA 0.64 µA 0.65 µA 0.64 µA 0.66 µA	
3.3 mA	(1 to 5) kHz	0.92 µA	
32.9 mA	10 Hz 45 Hz to 10 kHz 30 kHz	9.5 µA 6.2 µA 6.8 µA	
33 mA	1 kHz 5 kHz 30 kHz	9.1 µA 9.2 µA 9.3 µA	
329 mA	10 Hz 45 Hz (50 to 60) Hz (1 to 10) kHz 30 kHz	0.11 mA 0.069 mA 0.070 mA 0.069 mA 0.087 mA	
0.33 A	1 kHz (5 to 10) kHz	0.17 mA 0.16 mA	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Current – Measure (cont)			
2.99 A	50 Hz to 5 kHz	0.0017 A	Fluke 5790B, AC shunts
3.3 A	500 Hz 5 kHz	0.0031 A 0.0032 A	
10 A	(50 to 60) Hz 1 kHz 5 kHz	0.0080 A 0.0083 A 0.011 A	
20 A	50 Hz to 1 kHz 5 kHz	0.030 A 0.034 A	
190 µA to 1.9 mA	50 Hz 60 Hz 400 Hz to 10 kHz	130 µA/A + 0.0013 µA 130 µA/A + 0.0023 µA 110 µA/A + 0.0051 µA	
(1.9 to 19) mA	50 Hz 60 Hz 400 Hz to 5 kHz 10 kHz	130 µA/A 130 µA/A 120 µA/A 110 µA/A + 0.010 µA	
(19 to 190) mA	50 Hz 60 Hz 400 Hz to 5 kHz 10 kHz	120 µA/A + 0.20 µA 130 µA/A + 0.11 µA 120 µA/A + 0.20 µA 120 µA/A + 0.20 µA	
190 mA to 1.9 A	50 Hz to 60 Hz 400 Hz to 1 kHz 5 kHz 10 kHz	160 µA/A 160 µA/A 190 µA/A 530 µA/A	
AC Voltage Phase – Measure			
3 V/ (0 ± 10) ˚	65 Hz to 1 kHz 5 kHz 10 kHz 30 kHz	0.022 ˚ 0.048 ˚ 0.056 ˚ 0.063 ˚	Clarke-Hess 6000A
3 V/ (60 ± 10) ˚	60 Hz 400 Hz 1 kHz 5 kHz 10 kHz 30 kHz	0.026 ˚ 0.027 ˚ 0.025 ˚ 0.048 ˚ 0.058 ˚ 0.063 ˚	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage Phase – Measure (cont)			
3 V/ (90 ± 10) ˚	(60 to 65) Hz 400 Hz 1 kHz 5 kHz 10 kHz 30 kHz	0.022 ˚ 0.027 ˚ 0.027 ˚ 0.048 ˚ 0.058 ˚ 0.067 ˚	Clarke-Hess 6000A
30 V/ (90 ± 10) ˚ 50 V/ (90 ± 10) ˚	65 Hz 65 Hz	0.022 ˚ 0.035 ˚	
AC Current Phase – Measure			
300 mA/ (0 ± 10) ˚	65 Hz 1 kHz 30 kHz	0.025 ˚ 0.027 ˚ 0.066 ˚	For 300 mA & 2A; A40, 6000 A
2 A/ (0 ± 10) ˚	65 Hz	0.024 ˚	
5 A/ (0 ± 10) ˚	65 Hz 400 Hz	0.030 ˚ 0.030 ˚	For 5 A & 20 A; Y5020, 6000 A
300 mA/ (60 ± 10) ˚ 2 A/ (60 ± 10) ˚ 20 A/ (60 ± 10) ˚ 20 A/ (60 ± 10) ˚ 300 mA/ (90 ± 10) ˚ 2 A/ (90 ± 10) ˚ 20 A/ (90 ± 10) ˚ 20 A/ (90 ± 10) ˚	65 Hz	0.027 ˚ 0.026 ˚ 0.025 ˚ 0.032 ˚ 0.027 ˚ 0.025 ˚ 0.034 ˚ 0.039 ˚	
AC Capacitance – Measure			
0.22 nF 0.35 nF 0.48 nF 0.6 nF 1 nF 2 nF 7 nF 10.9 nF 20 nF	5 kHz 1 kHz 1 kHz 1 kHz 1 kHz 1 kHz 1 kHz 1 kHz 1 kHz	0.46 pF 0.39 pF 0.46 pF 0.48 pF 0.63 pF 1.2 pF 3.8 pF 6.6 pF 11 pF	PM 6304

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Capacitance – Measure (cont)			
70 nF	1 kHz	39 pF	PM 6304
109 nF	1 kHz	66 pF	
200 nF	1 kHz	0.11 nF	
300 nF	1 kHz	0.17 nF	
0.7 µF	100 Hz	0.40 nF	
1.09 µF	100 Hz	0.78 nF	
2 µF	100 Hz	1.2 nF	
3 µF	100 Hz	1.7 nF	
7 µF	100 Hz	3.9 nF	
10.9 µF	100 Hz	6.9 nF	
20 µF	100 Hz	12 nF	
30 µF	100 Hz	16 nF	
70 µF	50 Hz	41 nF	
109 µF	50 Hz	68 nF	
4 Terminal Parallel Capacitance – Generate[3]			
1 pF	1 MHz	12 fF	5880-SRU set of standard capacitors from 1 pF to 1000 pF
10 pF	100 kHz	0.014 pF	
	1 MHz	0.012 pF	
100 pF	10 kHz	0.18 pF	
	100 kHz	0.038 pF	
	1 MHz	0.042 pF	
1000 pF	10 kHz	0.88 pF	
	100 kHz	0.25 pF	
	1 MHz	0.82 pF	

Parameter/Equipment	Range	CMC[2, 4, 7] (±)	Comments
DC Capacitance – Measure	200 µF 300 µF 1 mF 3 mF 10 mF 30 mF 50 mF 100 mF	0.098 µF 0.11 µF 0.24 µF 0.45 µF 1.1 µF 3.4 µF 5 µF 9 µF	HP 3458A, 5522A
Oscilloscopes –			
Short Circuit Output	0 V	15 µV	Wavetek 9500, Fluke 9500B
Amplitude – DC Volts: 50 Ω & 1 MΩ Load	(1 to 100) mV 100 mV to 1.0 V (1.0 to 5.56) V	0.050 % + 26 µV 0.022 % + 65 µV 0.026 % + 50 µV	
1 MΩ Load	(5 to 200) V	0.030 %	
Amplitude - Sinewave, $V_{p-p;}$ 50 Ω Load	4.4 mV to 5.6 V 1 Hz to 550 MHz	0.033 V/V	Wavetek 9500, Fluke 9500B
	4.4 mV to 3.4 V 550 MHz to 2.5 GHz	0.063 V/V	Wavetek/Fluke 9530
	4.4 mV to 2.2 V (2.5 to 3.2) GHz	0.11 V/V	
RMS Noise – Measure	20 MHz BW 175 MHz BW (0.2 to 10) GHz BW	0.18 µV 2.2 µV 1.1 µV	Tektronix MSO series
DC Voltage – Generate	(48 to 52) mV (477 to 523) mV (0.97 to 1.03) V (1.9 to 2.1) V (4.8 to 5.2) V (9.6 to 10.4) V	0.11 mV 0.52 mV 0.8 mV 1.9 mV 5.8 mV 8.9 mV	Fluke 9500B Wavetek

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
Oscilloscopes – (cont)			
DC Voltage – Measure			
50 Ω	(0.03 to 0.25) V (1 to 1.5) V	0.12 V 0.13 V	Tektronix MSO series
1 MΩ	(0.03 to 0.7) V (2.5 to 3.3) V	0.17 V 0.17 V	
Leveled Sinewave Flatness			
50 Ω Load 50 kHz to 10 MHz Reference, V_{p-p}			Wavetek 9500, Fluke 9500B w/ 9530 head
1 Hz to 100 MHz (100 to 550) MHz 550 MHz to 1.1 GHz (1.1 to 2.5) GHz (2.5 to 3.2) GHz	4.4 mV to 5.6 V 4.4 mV to 5.6 V 4.4 mV to 3.4 V 4.4 mV to 3.4 V 4.4 mV to 2.2 V	0.22 dB 0.27 dB 0.37 dB 0.47 dB 0.48 dB	Synthesized signal generator w/ power sensor & power meter
1.0 GHz 2.0 GHz 2.5 GHz	Up to 800 mV Up to 800 mV Up to 800 mV	0.22 dB 0.27 dB 0.34 dB	
(3.2 to 8.0) GHz (3.2 to 8.0) GHz	Up to 300 mV > 300 mV	0.30 dB 0.31 dB	
(8.0 to 12.5) GHz (8.0 to 12.5) GHz	Up to 300 mV > 300 mV	0.37 dB 0.38 dB	
(12.5 to 16) GHz (12.5 to 16) GHz	Up to 300 mV > 300 mV	0.46 dB 0.42 dB	

Parameter/Equipment	Range	CMC[2, 4, 7] (±)	Comments
Oscilloscopes – (cont)			
Leveled Sinewave Flatness			
50 Ω Load 50 kHz to 10 MHz Reference, V_{p-p}			
(16 to 18) GHz (16 to 18) GHz	Up to 300 mV > 300 mV	0.52 dB 0.42 dB	Synthesized signal generator w/ power sensor & power meter
(18 to 20) GHz (18 to 20) GHz	Up to 300 mV > 300 mV	0.56 dB 0.40 dB	
(20 to 23) GHz (20 to 23) GHz	Up to 300 mV > 300 mV	0.55 dB 0.58 dB	
(23 to 25) GHz (23 to 25) GHz	Up to 300 mV > 300 mV	0.57 dB 0.61 dB	
(25 to 33) GHz (25 to 33) GHz	Up to 120 mV > 120 mV	0.87 dB 0.84 dB	
Time Marker[3]	1 ns to 100 ms	0.20 µs/s + 3 ps	Wavetek 9500, Fluke 9500B
Rise Time – Measuring Equipment	(14 ± 3) ps	4.7 ps	TDS 8200/80E04
Rise Time – Measure	17.5 ps to 10 ns	5.6 ps	
Input Resistance – Measure	50 Ω 75 Ω 1 MΩ	0.045 Ω 0.13 Ω 0.41 kΩ	Fluke 9500B/9530
Pulse Characterization – Measure, Fixed Points[3]			
Overshoot	0.5 V 2 V 5 V 20 V	0.50 % 0.53 % 0.46 % 0.45 %	Oscilloscope Tektronix MSO44
Preshoot	5 V 20 V	0.46 % 0.48 %	

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
Pulse Characterization – Measure, Fixed Points[3] (cont)			
Pulse Width	500 ns	0.11 ns	Oscilloscope Tektronix MSO44
RMS Jitter	0 s	0.017 ns	
Slew Rate	0.5 V/ns 0.2 V/ns	0.0061 V/ns 0.0025 V/ns	

II. Fluid Quantities

Parameter/Equipment	Range	CMC[2, 6, 7] (±)	Comments
Gas Flow – Measuring Equipment	(1 to 10) SCCM (20 to 200) SCCM (0.1 to 1) SLM (0.5 to 5) SLM	0.24 % 0.37 % 0.24 % 0.33 %	MOLBLOC 1E1 MOLBLOC 2E2 MOLBLOC 1E3 MOLBLOC 5E3 w/ MOLBOX 1

III. Mechanical

Parameter/Equipment	Range	CMC[2, 6, 7] (±)	Comments
Torque – Measuring Equipment	(3.5 to 35) N·cm (35 to 141) N·cm (1.41 to 5.65) N·m (5.65 to 45.2) N·m (45.2 to 113) N·m (113 to 339) N·m (339 to 813.6) N·m	0.32 % 0.34 % 0.34 % 0.32 % 0.35 % 0.30 % 0.33 %	Snap-on TTC4 Snap-on TTC5 CDI 2000-400-02 CDI 2000-12-02 w/ 2000-810-01

Parameter/Equipment	Range	CMC[2, 6] (±)	Comments
Gauge Pressure – Measuring Equipment (Pneumatic)	(-90 to 0) kPa (0 to 100) kPa (100 to 200) kPa (200 to 700) kPa (700 to 2000) kPa	0.041 kPa 0.024 kPa 0.033 kPa 0.14 kPa 0.26 kPa	Fluke PM500 w/ BG100K w/ BG200K w/ BG700K w/ BG2M; 6270A

IV. Time & Frequency

Parameter/Equipment	Frequency	CMC[2, 6] (±)	Comments
Frequency –			
Measuring Equipment	12 kHz to 3.2 GHz	0.27 µHz/Hz	Wavetek 9500 option 100, Fluke 9500B
Measure	10 MHz	0.33 mHz	Keysight 53181A-010 w/ GPS
	119 Hz 120 Hz 100 kHz	1.2 µHz 9.3 µHz 0.58 mHz	FCA3103 w/ GPS
	10 Hz 15 Hz 100 Hz 0.2 kHz 0.5 kHz 1 kHz 5 kHz 10 kHz 0.14 MHz 0.2 MHz 0.5 MHz 1 MHz	0.000 12 Hz 0.000 11 Hz 0.000 13 Hz 0.000 10 Hz 0.000 17 Hz 0.000 67 Hz 0.0011 Hz 0.0021 Hz 0.025 Hz 0.036 Hz 0.12 Hz 0.27 Hz	FCA3103 w/ GPS

[1] This laboratory offers commercial calibration service and field calibration service.

[2] 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 uncertainty due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

[3] Field calibration service is available for this calibration. 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.

[4] 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 percent or fraction of the reading plus a fixed floor specification.

[5] This scope meets A2LA's *P112 Flexible Scope Policy*.

[6] 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.

[7] In the statement of CMC, percent is defined as percent of reading.

[8] Tektronix & Fluke Corporation is also doing business as Keithley Instruments, LLC.

Accredited Laboratory

A2LA has accredited

TEKTRONIX & FLUKE CORPORATION

Kanagawa Pref., JAPAN

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 the requirements of ANSI/NCSL 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 12th day of September 2023.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2357.02
Valid to December 31, 2025

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