



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017
ANSI-NCSLI Z540-1-1994

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CALIBRATION

Valid To: May 31, 2028

Certificate Number: 0462.01

In recognition of the successful completion of the A2LA evaluation process (including an assessment of the organization's compliance with R205 – A2LA's Calibration Program Requirements), accreditation is granted to this laboratory to perform the following calibrations and dimensional inspections^{1, 10}:

I. Acoustical Quantities

Parameter/Range	Frequency	CMC ² (±)	Comments
Sound Level Meters ³ – (94, 104 & 114) dB 114 dB	(31.5 to 16 000) Hz (125 to 2000) Hz	0.27 dB 0.8 dB	B&K 4226 GenRad 1562
Sound Level Calibrators – (94, 104 & 114) dB	(31.5 to 16 000) Hz	0.27 dB	B&K 4226
Microphones ³ – Sensitivity @ 94 dB Frequency Response @ 94 dB	250 Hz Reference 31.5 Hz to 8 kHz (12.5 to 16) kHz	0.27 mV/Pa 0.3 dB 0.6 dB	B&K 2035 & 4226

II. Chemical

Parameter/Equipment	Range	CMC ² ($\pm$)	Comments
pH Meters, Fixed Points	4.00 pH 7.00 pH 10.00 pH	0.021 pH 0.021 pH 0.021 pH	pH buffer solutions

III. Dimensional

Parameter/Equipment	Range	CMC ^{2,4} ($\pm$)	Comments
Gage Blocks	Up to 1 in (1 to 4) in (5 to 20) in	(3.0 + 3.2L) μ in (4.0 + 3.2L) μ in (9.0 + 3.2L) μ in	By mechanical comparison
Gage Amplifier & Probe	Up to 0.07 in	11 μ in	Gage blocks
Angle Blocks	Up to 45°	0.63 sec	Amp & probe, sine bar, gage blocks
Calipers	Up to 80 in	(57 + 0.6R + 7.0L) μ in	Gage blocks
Length Standards	Up to 12 in (12 to 18) in (18 to 24) in (24 to 46) in (46 to 80) in	(35 + 3.2L) μ in (41 + 3.2L) μ in (51 + 3.2L) μ in (130 + 3.2L) μ in (150 + 3.2L) μ in	Standard measuring machine
Micrometers ³	Up to 72 in	(57 + 0.6R + 7.0L) μ in	Gage blocks
Tribore Micrometers	Up to 12 in	(14 + 8.0L + 0.6R) μ in.	Ring gages
Bore Gages	Up to 12 in	130 μ in	ULM
Indicators ³	Up to 0.1 in (0.1 to 6) in	80 μ in (130 + 6.5L) μ in	Indicator calibrator Gage blocks
Height Gages ³	Up to 24 in (24 to 40) in	(100 + 6.5L) μ in (110 + 6.5L) μ in	Gage blocks

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
OD Dimension – Cylindrical Plugs, Master Discs, Cylindrical Pins	Up to 7 in (7 to 12) in	(11 + 3.2L) μin (17 + 3.2L) μin	Universal comparator
Spheres	Up to 2 in	(14 + 3.2L) μin	Standard measuring machine
Cylindrical Rings – ID Dimension	(0.04 to 1) in (1 to 12) in	(10 + 3.2L) μin (21 + 3.2L) μin	Internal comparator ULM
Threaded Plugs – Pitch Diameter Major Diameter	Up to 4 in (4 to 20) in Up to 4 in (4 to 20) in	(60 + 3.2L) μin (85 + 3.2L) μin (44 + 3.2L) μin (71 + 3.2L) μin	Thread wires Standard measuring machine
Thread Measuring Wires – English, Metric, Acme, Whitworth & Buttress	Up to 0.014 in (0.014 to 0.028) in (0.028 to 0.500) in	12 μin 9 μin 12 μin	Universal comparator
Bench Micrometers – Linearity Anvil Parallelism Amplifier Anvil Pressure	Up to 1.0 in Up to 1.0 in Up to 1.0 in Up to 2.5 lb	(13 + 1.6L) μin 16 μin 16 μin 0.0039 lb	Gage blocks Load cell
Solid Thread Rings – Pitch Diameter Minor Diameter	(0.4375 to 4.5) in (4.5 to 20) in (0.03 to 0.5) in (0.5 to 4) in (4 to 20) in	(82 + 3.2L) μin (160 + 2.3L) μin (70 + 3.2L) μin (66 + 3.2L) μin (130 + 1.6L) μin	ULM Optek video Pins Tribore mics Optek video

Parameter/Equipment	Range	CMC ^{2, 4} ($\pm$)	Comments
Surface Plate ³ – Overall Flatness Repeat Reading	Up to 24 in (25 to 250) in Up to 0.001 in	$(71 + 2.5D) \mu\text{in}$ $(25 + 2.5D) \mu\text{in}$ 20 μin	Planekator Levels Repeat-o-meter
Surface Flatness	Up to 10 in	4.3 μin	Optical flat, monochromatic light
Surface Finish – Profilometer Roughness Specimen	Up to 250 μin Up to 250 μin	$(5.8 + 0.60R) \mu\text{in}$ 3.0 μin	Roughness patch Profilometer
Linear Displacement with Laser ³	Up to 40 in (> 40 to 300) in	$(9.7 + 1.8L) \mu\text{in}$ 2.1L μin	Laser
Optical Comparators ³ – X & Y Axes: Glass Scales Other Scales	Up to 12 in Up to 12 in	$(200 + 4.0L) \mu\text{in}$ $(190 + 6.5L) \mu\text{in}$	Glass master & precision balls
Glass Scale Inspection Masters	Up to 24 in	$(87 + 1.6L) \mu\text{in}$	Optek video
CMM ³ – Repeatability Linearity Volumetric Bi-Directional	Up to 40 in	62 μin $(120 + 1.6L)$ $(130 + 1.6L)$ 55 μin	Test sphere Check master Ball bar Gage block

IV. Dimensional Testing/Calibration⁷

Parameter/Equipment	Range	CMC ^{2, 4, 9} ($\pm$)	Comments
Dimensional Measurements –	Up to 40 in	$(120 + 3.2L) \mu\text{in}$	CMM (substitution method)
1-D Measurement	Up to 60 in	$(320 + 7.2L) \mu\text{in}$	CMM
2-D Measurement	Up to 48 in	$(560 + 10L) \mu\text{in}$	
3-D Measurement	Up to 36 in	$(640 + 11L) \mu\text{in}$	
1-D Measurement	Up to 24 in	$(87 + 1.4L) \mu\text{in}$	Video CMM; non-contact measurement
2-D Measurement	Up to 18 in	$(120 + 1.6L) \mu\text{in}$	
3-D Measurement	Up to 6 in	$(150 + 0.8L) \mu\text{in}$	

V. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 5, 6} ($\pm$)	Comments
DC Current ³ – Measure	Up to 200 μA 200 μA to 2 mA (2 to 20) mA (20 to 200) mA (0.2 to 2) A (2 to 20) A (2 to 150) A	13 $\mu\text{A/A} + 0.4 \text{ nA}$ 13 $\mu\text{A/A} + 4.0 \text{ nA}$ 15 $\mu\text{A/A} + 40 \text{ nA}$ 50 $\mu\text{A/A} + 0.8 \mu\text{A}$ 0.019 % + 16 μA 0.04 % + 400 μA 0.1 %	Fluke 8508A L&N 4224/4223
DC Current ³ – Generate	Up to 220 μA 220 μA to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A (2.2 to 3) A (3 to 11) A (11 to 20.5) A (20.5 to 1000) A	42 $\mu\text{A/A} + 6.0 \text{ nA}$ 37 $\mu\text{A/A} + 7.0 \text{ nA}$ 40 $\mu\text{A/A} + 40 \text{ nA}$ 46 $\mu\text{A/A} + 0.7 \mu\text{A}$ 83 $\mu\text{A/A} + 12 \mu\text{A}$ 0.039 % + 40 μA 0.051 % + 0.5 mA 0.11 % + 0.75 mA 0.84 % + 0.5 mA	Fluke 5720A Fluke 5520A Fluke 50 turn coil, clamp-on meters
DC Voltage ³ – Measure	Up to 200 mV 200 mV to 2 V (2 to 20) V (20 to 200) V (200 to 1000) V	8.5 $\mu\text{V/V} + 0.1 \mu\text{V}$ 4.2 $\mu\text{V/V} + 0.4 \mu\text{V}$ 4.1 $\mu\text{V/V} + 4.0 \mu\text{V}$ 5.6 $\mu\text{V/V} + 40 \mu\text{V}$ 5.6 $\mu\text{V/V} + 500 \mu\text{V}$	Fluke 8508A

Parameter/Equipment	Range	CMC ^{2,5} ($\pm$)	Comments
DC High Voltage ³ – Measure	(1 to 5) kV	0.4 % + 5.4 V	Fluke 5320A
DC Voltage ³ – Generate	Up 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	7.6 μ V/V + 0.4 μ V 5.6 μ V/V + 0.7 μ V 3.8 μ V/V + 2.5 μ V 3.8 μ V/V + 4.0 μ V 5.4 μ V/V + 40 μ V 6.8 μ V/V + 400 μ V	Fluke 5720A
Resistance ³ – Measure	0.1 m Ω to 2 Ω (2 to 20) Ω (20 to 200) Ω 200 Ω to 2 k Ω (2 to 20) k Ω (20 to 200) k Ω 200 k Ω to 2 M Ω (2 to 20) M Ω (20 to 200) M Ω 200 M Ω to 2 G Ω (2 to 20) G Ω	20 $\mu\Omega/\Omega$ + 4.0 $\mu\Omega$ 11 $\mu\Omega/\Omega$ + 14 $\mu\Omega$ 8.3 $\mu\Omega/\Omega$ + 50 $\mu\Omega$ 8.3 $\mu\Omega/\Omega$ + 0.5 m Ω 8.3 $\mu\Omega/\Omega$ + 5.0 m Ω 8.6 $\mu\Omega/\Omega$ + 50 m Ω 11 $\mu\Omega/\Omega$ + 1.0 Ω 25 $\mu\Omega/\Omega$ + 100 Ω 80 $\mu\Omega/\Omega$ + 1.0 k Ω 0.021 % + 100 k Ω 0.18 % + 10 M Ω	Fluke 8508A
Resistance ³ – Generate	(0 to 11) Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω (330 to 1100) Ω (1.1 to 3.3) k Ω (3.3 to 11) k Ω (11 to 33) k Ω (33 to 110) k Ω (110 to 330) k Ω 330 k Ω to 1.1 M Ω (1.1 to 3.3) M Ω (3.3 to 11) M Ω (11 to 33) M Ω (33 to 110) M Ω (110 to 330) M Ω (330 to 1100) M Ω	42 $\mu\Omega/\Omega$ + 1.0 m Ω 33 $\mu\Omega/\Omega$ + 1.5 m Ω 29 $\mu\Omega/\Omega$ + 1.4 m Ω 29 $\mu\Omega/\Omega$ + 2.0 m Ω 29 $\mu\Omega/\Omega$ + 2.0 m Ω 30 $\mu\Omega/\Omega$ + 20 m Ω 30 $\mu\Omega/\Omega$ + 20 m Ω 31 $\mu\Omega/\Omega$ + 0.2 Ω 30 $\mu\Omega/\Omega$ + 0.2 Ω 33 $\mu\Omega/\Omega$ + 2.0 Ω 34 $\mu\Omega/\Omega$ + 2.0 Ω 62 $\mu\Omega/\Omega$ + 30 Ω 0.014 % + 50 Ω 0.026 % + 2.5 k Ω 0.051 % + 3.0 k Ω 0.3 % + 0.1 M Ω 1.5 % + 0.5 M Ω	Fluke 5520A
Fixed Values	0.1 m Ω 1 m Ω 10 m Ω 100 m Ω 1 Ω 10 Ω 100 Ω 1 k Ω 10 k Ω 100 k Ω 1 M Ω	51 $\mu\Omega/\Omega$ 55 $\mu\Omega/\Omega$ 50 $\mu\Omega/\Omega$ 50 $\mu\Omega/\Omega$ 55 $\mu\Omega/\Omega$ 59 $\mu\Omega/\Omega$ 53 $\mu\Omega/\Omega$ 51 $\mu\Omega/\Omega$ 51 $\mu\Omega/\Omega$ 61 $\mu\Omega/\Omega$ 52 $\mu\Omega/\Omega$	L&N 4223/4224 other L&N standards

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Capacitance – Generate	(0 to 0.4) nF (0.4 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 (110 to 330) µF (0.33 to 1.1) mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF	0.51 % + 0.01 nF 0.51 % + 0.01 nF 0.51 % + 0.01 nF 0.25 % + 0.01 nF 0.25 % + 0.1 nF 0.25 % + 0.1 nF 0.25 % + 0.3 nF 0.25 % + 1.0 nF 0.25 % + 3.0 nF 0.25 % + 10 nF 0.4 % + 30 nF 0.45 % + 100 nF 0.45 % + 300 nF 0.46 % + 1.0 µF 0.47 % + 3.0 µF 0.46 % + 10 µF 0.75 % + 30 µF 1.1 % + 100 µF	Fluke 5520A
Capacitance – Measure	(0.3 to 300) nF (0.3 to 1) µF	(0.12 % + 0.000 26) nF (0.17 % - 0.17) nF	PM6306

Parameter/Equipment	Frequency	CMC ^{2,5} (±)	Comments
Inductance – Generate 100 mH	100 Hz to 10 kHz	0.13 mH	Transfer method using PM6306 & inductors
Inductance – Measure 100 mH	100 Hz to 10 kHz	0.13 mH	PM6306

Parameter/Range	Frequency	CMC ^{2, 5} (±)	Comments
AC Current ³ – Measure			
Up to 200 µA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.051 % + 20 nA 0.051 % + 20 nA 0.074 % + 20 nA 0.4 % + 20 nA	Fluke 8508A
200 µA to 2 mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.032 % + 0.2 µA 0.031 % + 0.2 µA 0.072 % + 0.2 µA 0.4 % + 0.2 µA	
(2 to 20) mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.032 % + 2.0 µA 0.031 % + 2.0 µA 0.072 % + 2.0 µA 0.4 % + 2.0 µA	
(20 to 200) mA	(1 to 10) Hz 10 Hz to 30 kHz (30 to 100) kHz	0.032 % + 20 µA 0.03 % + 20 µA 0.063 % + 20 µA	
(0.2 to 2) A	10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz	0.063 % + 200 µA 0.063 % + 200 µA 0.074 % + 200 µA	
(2 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	0.083 % + 2.0 mA 0.26 % + 2.0 mA	
AC Current ³ – Generate			
Up to 220 µA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.027 % + 16 nA 0.018 % + 16 nA 0.013 % + 8.0 nA 0.033 % + 12 nA 0.12 % + 65 nA	Fluke 5720A
	(10 to 30) kHz	1.6 % + 400 nA	Fluke 5520A
(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	0.028 % + 40 nA 0.018 % + 35 nA 0.013 % + 35 nA 0.021 % + 110 nA 0.11 % + 650 nA	Fluke 5720A
	(10 to 30) kHz	0.4 % + 500 nA	Fluke 5520A

Parameter/Range	Frequency	CMC ^{2, 5, 6} ($\pm$)	Comments
AC Current ³ – Generate (cont)			
(2.2 to 22) mA	(10 to 20) Hz	0.028 % + 400 nA	Fluke 5720A
	(20 to 40) Hz	0.018 % + 350 nA	
	40 Hz to 1 kHz	0.013 % + 350 nA	
	(1 to 5) kHz	0.022 % + 550 nA	
	(5 to 10) kHz	0.12 % + 5.0 μ A	
	(10 to 30) kHz	0.4 % + 500 nA	
(22 to 220) mA	(10 to 20) Hz	0.028 % + 4.0 μ A	Fluke 5720A
	(20 to 40) Hz	0.018 % + 3.5 μ A	
	40 Hz to 1 kHz	0.013 % + 2.5 μ A	
	(1 to 5) kHz	0.021 % + 3.5 μ A	
	(5 to 10) kHz	0.12 % + 10 μ A	
	(10 to 30) kHz	0.40 % + 200 μ A	
(0.22 to 2.2) A	20 Hz to 1 kHz	0.027 % + 35 μ A	
	(1 to 5) kHz	0.046 % + 80 μ A	
	(5 to 10) kHz	0.71 % + 160 μ A	
(2.2 to 2.9) A	(10 to 45) Hz	0.18 % + 100 μ A	Fluke 5520A
	45 Hz to 1 kHz	0.061 % + 100 μ A	
	(1 to 5) kHz	0.6 % + 1.0 mA	
	(5 to 10) kHz	2.5 % + 5.0 mA	
(2.9 to 11) A	(45 to 100) Hz	0.17 % + 2.0 mA	
	100 Hz to 1 kHz	0.11 % + 2.0 mA	
	(1 to 5) kHz	0.11 % + 2.0 mA	
(11 to 20.5) A	(45 to 100) Hz	0.13 % + 2.0 mA	
	100 Hz to 1 kHz	0.15 % + 5.0 mA	
	(1 to 5) kHz	3.0 % + 5.0 mA	
(20.5 to 1000) A	(45 to 65) Hz	0.73 %	Fluke 50 turn coil, clamp-on meters
	(65 to 440) Hz	1.3 %	

Parameter/Range	Frequency	CMC ^{2, 5} ($\pm$)	Comments
AC Voltage ³ – Measure			
Up to 200 mV	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.029 % + 2.0 μ V 0.019 % + 2.0 μ V 0.012 % + 4.0 μ V 0.013 % + 2.0 μ V 0.014 % + 4.0 μ V 0.035 % + 8.0 μ V 0.078 % + 20 μ V	Fluke 8508A
(0.2 to 2) V	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.026 % + 9.0 μ V 0.018 % + 20 μ V 0.011 % + 20 μ V 0.079 % + 20 μ V 0.012 % + 20 μ V 0.023 % + 40 μ V 0.059 % + 200 μ V 0.3 % + 2.0 mV 1.0 % + 20 mV	
(2 to 20) V	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.031 % + 80 μ V 0.016 % + 120 μ V 96 μ V/V + 0.2 mV 80 μ V/V + 0.2 mV 0.012 % + 0.2 mV 0.023 % + 0.4 mV 0.058 % + 2.0 mV 0.3 % + 20 mV 1.0 % + 200 mV	
(20 to 200) V	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.040 % + 2.0 mV 0.017 % + 1.0 mV 0.011 % + 2.0 mV 85 μ V/V + 2.0 mV 0.012 % + 2.0 mV 0.023 % + 4.0 mV 0.058 % + 20 mV 0.3 % + 200 mV 1.0 % + 2.0 V	
(200 to 1000) V	(1 to 10) Hz (10 to 40) Hz 40 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.027 % + 10 mV 0.030 % + 7.0 mV 0.012 % + 20 mV 0.023 % + 40 mV 0.059 % + 70 mV	

Parameter/Range	Frequency	CMC ^{2,5} ($\pm$)	Comments
AC High Voltage ³ – Measure (1 to 5) kV	60 Hz	0.6 % + 5.6 V	Fluke 5320A
AC Voltage ³ – Generate Up 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 500 kHz to 1 MHz	0.97 % + 4.0 μ V 0.23 % + 4.0 μ V 0.18 % + 4.0 μ V 0.23 % + 4.0 μ V 0.19 % + 5.0 μ V 0.26 % + 10 μ V 0.24 % + 20 μ V 0.37 % + 20 μ V	Fluke 5720A
(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 500 kHz to 1 MHz	0.11 % + 4.0 μ V 0.03 % + 4.0 μ V 0.015 % + 4.0 μ V 0.028 % + 4.0 μ V 0.058 % + 5.0 μ V 0.12 % + 10 μ V 0.16 % + 20 μ V 0.28 % + 20 μ V	
(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 500 kHz to 1 MHz	0.025 % + 12 μ V 99 μ V/V + 7.0 μ V 83 μ V/V + 7.0 μ V 0.021 % + 7.0 μ V 0.047 % + 17 μ V 0.091 % + 20 μ V 0.15 % + 25 μ V 0.28 % + 45 μ V	
(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 500 kHz to 1 MHz	0.026 % + 40 μ V 97 μ V/V + 15 μ V 50 μ V/V + 8.0 μ V 82 μ V/V + 10 μ V 0.012 % + 30 μ V 0.044 % + 80 μ V 0.11 % + 200 μ V 0.18 % + 300 μ V	

Parameter/Range	Frequency	CMC ^{2, 5} (±)	Comments
AC Voltage ³ – Generate (cont)			Fluke 5720A
(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 500 kHz to 1 MHz	0.025 % + 400 µV 97 µV/V + 150 µV 50 µV/V + 50 µV 81 µV/V + 100 µV 0.011 % + 200 µV 0.003 % + 600 µV 0.11 % + 2.0 mV 0.16 % + 3.2 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	0.025 % + 4.0 mV 97 µV/V + 1.5 mV 56 µV/V + 0.6 mV 91 µV/V + 1.0 mV 0.016 % + 2.5 mV	
(220 to 1100) V	(15 to 50) Hz 50 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.031 % + 16 mV 77 µV/V + 3.5 mV 0.026 % + 10 mV 0.031 % + 10 mV	Fluke 5520A

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of Thermocouple Indicators ³ –			
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	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	0.58 °C 0.19 °C 0.16 °C 0.19 °C 0.24 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of Thermocouple Indicators ³ – (cont)			
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.31 °C 0.19 °C 0.16 °C 0.2 °C 0.27 °C	Fluke 5520A
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.38 °C 0.21 °C 0.18 °C 0.30 °C 0.46 °C	
Type L	(-200 to -100) °C (-100 to 800) °C (800 to 900) °C	0.42 °C 0.30 °C 0.20 °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	0.66 °C 0.40 °C 0.38 °C 0.46 °C	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.54 °C 0.42 °C 0.43 °C 0.53 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.73 °C 0.28 °C 0.18 °C 0.16 °C	
Type U	(-200 to 0) °C (0 to 600) °C	0.65 °C 0.31 °C	

Parameter/Equipment	Range	CMC ^{2,4} ($\pm$)	Comments
Electrical Calibration of RTD Indicators ³ –	(-20 to 0) °C (Up to 125) °C (> 125 to 250) °C	(0.028 – 0.000 22T) °C (0.038 + 0.000 72T) °C (0.05 + 0.001T) °C	Fluke 8508, PRT, & temperature well

VI. Fluid Quantities

Parameter/Equipment	Range	CMC ² ($\pm$)	Comments
Viscosity Cups	Zahn #2 Zahn #3, 4	0.41 s 0.44 s	Temperature bath, viscosity oils, stopwatch

VII. Mechanical

Parameter/Equipment	Range	CMC ^{2,4,6} ($\pm$)	Comments
Mass	1 mg to 100 g 100 g to 3 kg (3 to 25) kg 50 lbs (22.6796 kg)	0.17 mg 16 mg 0.45 g 0.53 g	Comparison to standard weights, Class 4, 6, & F weights only
Scales & Balances ³	(1 to 500) mg 500 mg to 100 g 100 g to 12 kg (50 to 1000) lb (1000 to 5000) lb	0.018 mg 0.16 mg 20 mg + 3.6 μ g/g 0.12 lb 0.59 lb	Verification with Class 1, 4 & F weights
Tachometers –			
Contact	Up to 40 000 RPM	0.02 %	Tachometer calibrator
Non-Contact	Up to 200 000 RPM	0.012 %	Universal counter

Parameter/Equipment	Range	CMC ^{2, 4, 6} ($\pm$)	Comments
Pressure Gauges & Transducers ³	(-13 to 300) psi (300 to 60 000) psi	0.007 psi + 0.10 % 0.12 %	Electronic pressure tester Dead weight tester & transducer
Force – Load Cells, Compression & Tension Testing Machines ³	Up to 25 000 lbf	0.45 % + 0.60 <i>R</i> lbf	Load cells & precision weights
Torque – Laboratory: Transducers Tools On-Site: ³ Transducers Tools	Up to 1000 lbf·ft (Up to 2000) lbf·ft Up to 250 lbf·ft Up to 1000 lbf·ft	0.66 % 1.1 % 0.75 % 1.1 %	Weight & torque arm torque transducer
Accelerometers ³ – Sensitivity Frequency Response	159.15 Hz Up to 15 kHz (> 15 to 20) kHz	0.14 mV/g 0.25 dB 0.43 dB	B&K 4294 Back-to-back comparison to reference accelerometer
Indirect Verification of Brinell Hardness Testers at Test Conditions ^{3, 8} – HBW 10/500/15 HBW 10/1000/15 HBW 10/3000/15	(50 to 130) HBW (90 to 140) HBW (200 to 350) HBW	0.04 <i>d</i> HBW 0.04 <i>d</i> HBW 0.04 <i>d</i> HBW	Indirect verification per ASTM E10 <i>d</i> is the mean of the <i>n</i> mean test diameters in millimeters CMC is stated as a percentage of the standardized test block hardness value

Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Microindentation Hardness Testers – (Knoop & Vickers)			Indirect verification per ASTM E92
Repeatability Under Forces P (gf)			
$1 < P < 500$	(441 to 829) HK (401 to 769) HV	1.9 % HK 3.2 % HV	CMC is stated as the repeatability as defined in ASTM E92
$500 < P < 1000$	(411 to 759) HK (391 to 729) HV	3.6 % HK 1.1 % HV	
Indirect Verification of Rockwell & Rockwell Superficial Hardness Testers ³	HRA: Low Medium High HRBW: Low Medium High HRC: Low Medium High HRFW: Low Medium High HR15N: Low Medium High HR30N: Low Medium High HR45N: Low Medium High	1.0 HRA 0.8 HRA 0.8 HRA 1.1 HRB 1.1 HRB 1.1 HRB 0.7 HRC 0.7 HRC 0.6 HRC 1.4 HRF 1.4 HRF 1.1 HRF 1.3 HR15N 1.2 HR15N 1.2 HR15N 1.4 HR30N 1.5 HR30N 1.2 HR30N 1.0 HR45N 1.0 HR45N 1.0 HR45N	Indirect verification per ASTM E18

Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Rockwell & Rockwell Superficial Hardness Testers ³ (cont)	HR15TW: Low Medium High HR30TW: Low Medium High HR45TW: Low Medium High	0.9 HR15TW 1.0 HR15TW 1.0 HR15TW 1.6 HR30TW 1.4 HR30TW 1.4 HR30TW 1.3 HR45TW 1.0 HR45TW 1.0 HR45TW	Indirect verification per ASTM E18
Direct Verification of Durometers – Verification of Indenter Shape & Extension: Extension at Zero Reading Types A & C 35 Right Circular Conical Frustum	--- Diameter of the Base of the Frustum Diameter of the Top of the Frustum Cone Angle	1.0 µm 6.0 µm 6.0 µm 0.06°	Direct verification per ASTM D2240 The dimensional characteristics of the indenters are verified by optical projection

Parameter/Equipment	Range	CMC ² (±)	Comments
Direct Verification of Durometers – (cont)			Direct verification per ASTM D2240
Verification of Indenter Shape & Extension:	Diameter of the Base of the Cone	6.0 µm	The dimensional characteristics of the indenters are verified by optical projection
Types B, D, & M	Cone Angle	0.06°	
	Tip Radius	6.0 µm	
Types DO, O, & OO	Indenter Thickness	6.0 µm	The durometer spring is verified with a durocalibrator. The CMC applies to all durometer types
	Indenter Radius	6.0 µm	
Verification of the Durometer Spring	---	42 mN	

VIII. Thermodynamics

Parameter/Equipment	Range	CMC ^{2,9} (±)	Comments
Temperature ³ – Measure	(-197 to 0) °C (0 to 400) °C (400 to 660) °C	0.014 °C 0.033 °C 0.044 °C	Fluke reference SPRT
Temperature ³ – Measuring Equipment	(-20 to 125) °C (126 to 500) °C	0.071 °C 0.6 °C	Fluke reference SPRT w/ Hart 7103 Fluke reference SPRT w/ Hart 9141
Infrared Thermometers ³	(-15 to 100) °C (100 to 200) °C (200 to 350) °C (350 to 500) °C	0.74 °C 1.0 °C 1.7 °C 2.2 °C	Fluke 4180 & 4181 Spectral wavelength = (8 to 14) µm, emissivity = 0.95
Relative Humidity – Measure & Measuring Equipment	(10 to 90) % RH	2.2 % RH	Vaisala HMP77 Blue M chamber

IX. Time & Frequency

Parameter/Equipment	Range	CMC ^{2,9} ($\pm$)	Comments
Frequency –			
Fixed Point	10 MHz	1.0×10^{-10} Hz/Hz	GPS system
Measure ³ & Generate ³	0.01 Hz to 1 kHz > 1 kHz to 1.3 GHz	6.5 μ Hz + 0.12 μ Hz/Hz 1.0 mHz + 11 mHz/MHz	Function generator, signal generator, frequency counter or spectrum analyzer with ext. GPS timebase
Stopwatches & Timers	60 s 300 s 3600 s 21 600 s 86 400 s	0.51 s 0.053 s 0.081 s 0.093 s 0.21 s	GPS system with counter

¹ This laboratory offers commercial dimensional 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 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 In the statement of CMC, L is the numerical value of the nominal length of the device measured in inches, and D is the numerical value of the diagonal length of the device measured in inches. R is the resolution of the device measured in inches. T is the temperature reading in Celsius.

⁵ The measurands stated are generated with the Fluke 5520A, 5720A, or 8508A series of instruments. This capability is suitable for the calibration of the devices intended to measure the stated measurand in the ranges indicated. 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.

⁶ In the statement of CMC, percentages are to be read as percent of reading, unless otherwise noted.

⁷ This laboratory meets R205 – *Specific Requirements: Calibration Laboratory Accreditation Program* for the types of dimensional calibrations listed above. Accredited test reports issued containing appropriate statements of measurement results, measurement uncertainty, and traceability are considered equivalent to a “calibration” certificate.

⁸ The notation 10/3000/15 gives the conditions of the verification: the 10 is the indenter diameter in millimeters, the 3000 is the test force in kilogram-force, and the 15 is the force application duration in seconds.

⁹ 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.

¹⁰ This scope meets A2LA’s *P112 Flexible Scope Policy*.