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

QUALITY CALIBRATION SERVICE, INC.
5515 S Westridge Dr.
New Berlin, WI 53151
Martin Lukomski Phone: 414 256 8900

CALIBRATION

Valid To: May 31, 2024 Certificate Number: 0462.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations and dimensional inspections[1, 10]:

I. Acoustical Quantities

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

II. Chemical

Parameter/Equipment	Range	CMC[2] (±)	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] (±)	Comments
Gage Blocks	Up to 1 in (1 to 4) in (5 to 20) in	(3.0 + 3.2*L*) µin (4.0 + 3.2*L*) µin (9.0 + 3.2*L*) µin	By mechanical comparison
Gage Amplifier & Probe	Up to 0.07 in	11 µin	Gage blocks
Angle Blocks	Up to 45°	0.63 sec	Amp & probe, sine bar, gage blocks
Calipers	Up to 80 in	(57 + 0.6*R* + 7.0*L*) µin	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 + 3.2*L*) µin (41 + 3.2*L*) µin (51 + 3.2*L*) µin (130 + 3.2*L*) µin (150 + 3.2*L*) µin	Standard measuring machine
Micrometers[3]	Up to 72 in	(57 + 0.6*R* + 7.0*L*) µin	Gage blocks
Tribore Micrometers	Up to 12 in	(14 + 8.0*L* + 0.6*R*) µin.	Ring gages
Bore Gages	Up to 12 in	130 µin	ULM
Indicators[3]	Up to 0.1 in (0.1 to 6) in	80 µin (130 + 6.5*L*) µin	Indicator calibrator Gage blocks
Height Gages[3]	Up to 24 in (24 to 40) in	(100 + 6.5*L*) µin (110 + 6.5*L*) µin	Gage blocks
OD Dimension – Cylindrical Plugs, Master Discs, Cylindrical Pins	Up to 7 in (7 to 12) in	(11 + 3.2*L*) µin (17 + 3.2*L*) µin	Universal comparator
Spheres	Up to 2 in	(14 + 3.2*L*) µin	Standard measuring machine

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
Cylindrical Rings – ID Dimension	(0.04 to 1) in (1 to 12) in	(10 + 3.2*L*) µin (21 + 3.2*L*) µin	Internal comparator ULM
Threaded Plugs –			
Pitch Diameter	Up to 4 in (4 to 20) in	(60 + 3.2*L*) µin (85 + 3.2*L*) µin	Thread wires
Major Diameter	Up to 4 in (4 to 20) in	(44 + 3.2*L*) µin (71 + 3.2*L*) µin	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	Up to 1.0 in	(13 + 1.6*L*) µin	Gage blocks
Anvil Parallelism	Up to 1.0 in	16 µin	
Amplifier	Up to 1.0 in	16 µin	
Anvil Pressure	Up to 2.5 lb	0.0039 lb	Load cell
Thread Rings –			
Pitch Diameter	Up to 4.5 in (0.4375 to 4.5) in (4.5 to 20) in	(170 + 3.2*L*) µin (82 + 3.2*L*) µin (160 + 2.3*L*) µin	Setting plugs ULM Optek video
Minor Diameter	(0.03 to 0.5) in (0.5 to 4) in (4 to 20) in	(70 + 3.2*L*) µin (66 + 3.2*L*) µin (130 + 1.6*L*) µin	Pins Tribor mics Optek video
Surface Plate Flatness[3]	Overall Flatness Up to 24 in (25 to 250) in Repeat Reading Up to 0.001 in	 (71 + 2.5*D*) µin (25 + 2.5*D*) µin 20 µin	 Planekator Levels Repeat-o-meter
Surface Flatness	Up to 10 in	4.3 µin	Optical flat, monochromatic light

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
Surface Finish –			
Profilometer	Up to 250 µin	(5.8 + 0.60*R*) µin	Roughness patch
Roughness Specimen	Up to 250 µin	3.0 µin	Profilometer
Linear Displacement with Laser[3]	Up to 40 in (> 40 to 300) in	(9.7 + 1.8*L*) µin 2.1*L* µin	Laser
Optical Comparators[3] –			
X & Y Axes:			
Glass Scales	Up to 12 in	(200 + 4.0*L*) µin	Glass master & precision balls
Other Scales	Up to 12 in	(190 + 6.5*L*) µin	
Glass Scale Inspection Masters	Up to 24 in	(87 + 1.6*L*) µin	Optek video
CMM[3] –			
Repeatability	Up to 40 in	62 µin	Test sphere
Linearity		(120 + 1.6*L*)	Check master
Volumetric		(130 + 1.6*L*)	Ball bar
Bi-Directional		55 µin	Gage block

IV. Dimensional Testing/Calibration[7]

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

V. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC[2, 5, 6] (±)	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 µA/A + 0.4 nA 13 µA/A + 4.0 nA 15 µA/A + 40 nA 50 µA/A + 0.8 µA 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 µA/A + 6.0 nA 37 µA/A + 7.0 nA 40 µA/A + 40 nA 46 µA/A + 0.7 µA 83 µA/A + 12 µA 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 µV/V + 0.1 µV 4.2 µV/V + 0.4 µV 4.1 µV/V + 4.0 µV 5.6 µV/V + 40 µV 5.6 µV/V + 500 µV	Fluke 8508A
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 µV/V + 0.4 µV 5.6 µV/V + 0.7 µV 3.8 µV/V + 2.5 µV 3.8 µV/V + 4.0 µV 5.4 µV/V + 40 µV 6.8 µV/V + 400 µV	Fluke 5720A
Resistance[3] – Measure	0.1 mΩ to 2 Ω (2 to 20) Ω (20 to 200) Ω 200 Ω to 2 kΩ (2 to 20) kΩ (20 to 200) kΩ 200 kΩ to 2 MΩ (2 to 20) MΩ (20 to 200) MΩ 200 MΩ to 2 GΩ (2 to 20) GΩ	20 µΩ/Ω + 4.0 µΩ 11 µΩ/Ω + 14 µΩ 8.3 µΩ/Ω + 50 µΩ 8.3 µΩ/Ω + 0.5 mΩ 8.3 µΩ/Ω + 5.0 mΩ 8.6 µΩ/Ω + 50 mΩ 11 µΩ/Ω + 1.0 Ω 25 µΩ/Ω + 100 Ω 80 µΩ/Ω + 1.0 kΩ 0.021 % + 100 kΩ 0.18 % + 10 MΩ	Fluke 8508A

Parameter/Equipment	Range	CMC[2, 5] (±)	Comments
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) kΩ (3.3 to 11) kΩ (11 to 33) kΩ (33 to 110) kΩ (110 to 330) kΩ 330 kΩ to 1.1 MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ (330 to 1100) MΩ	42 µΩ/Ω + 1.0 mΩ 33 µΩ/Ω + 1.5 mΩ 29 µΩ/Ω + 1.4 mΩ 29 µΩ/Ω + 2.0 mΩ 29 µΩ/Ω + 2.0 mΩ 30 µΩ/Ω + 20 mΩ 30 µΩ/Ω + 20 mΩ 31 µΩ/Ω + 0.2 Ω 30 µΩ/Ω + 0.2 Ω 33 µΩ/Ω + 2.0 Ω 34 µΩ/Ω + 2.0 Ω 62 µΩ/Ω + 30 Ω 0.014 % + 50 Ω 0.026 % + 2.5 kΩ 0.051 % + 3.0 kΩ 0.3 % + 0.1 MΩ 1.5 % + 0.5 MΩ	Fluke 5520A
Fixed Values	0.1 mΩ 1 mΩ 10 mΩ 100 mΩ 1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ	51 µΩ/Ω 55 µΩ/Ω 50 µΩ/Ω 50 µΩ/Ω 55 µΩ/Ω 59 µΩ/Ω 53 µΩ/Ω 51 µΩ/Ω 51 µΩ/Ω 61 µΩ/Ω 52 µΩ/Ω	L&N 4223/4224 other L&N standards
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

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 uA 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] (±)	Comments
AC Current[3] – Generate (cont)			
(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	0.028 % + 400 nA 0.018 % + 350 nA 0.013 % + 350 nA 0.022 % + 550 nA 0.12 % + 5.0 µA	Fluke 5720A
	(10 to 30) kHz	0.4 % + 500 nA	Fluke 5520A
(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 (10 to 30) kHz	0.028 % + 4.0 µA 0.018 % + 3.5 µA 0.013 % + 2.5 µA 0.021 % + 3.5 µA 0.12 % + 10 µA 0.40 % + 200 µA	Fluke 5720A
(0.22 to 2.2) A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.027 % + 35 µA 0.046 % + 80 µA 0.71 % + 160 µA	
(2.2 to 2.9) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.18 % + 100 µA 0.061 % + 100 µA 0.6 % + 1.0 mA 2.5 % + 5.0 mA	Fluke 5520A
(2.9 to 11) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.17 % + 2.0 mA 0.11 % + 2.0 mA 0.11 % + 2.0 mA	
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.13 % + 2.0 mA 0.15 % + 5.0 mA 3.0 % + 5.0 mA	
(20.5 to 1000) A	(45 to 65) Hz (65 to 440) Hz	0.73 % 1.3 %	Fluke 50 turn coil, clamp-on meters

Parameter/Equipment	Range	CMC2, 5, 6 (±)	Comments
AC High Voltage[3] – Measure at 60 Hz	(1 to 5) kV	0.6 % + 5.6 V	Fluke 5320A

Parameter/Range	Frequency	CMC[2, 5] (±)	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 µV 0.019 % + 2.0 µV 0.012 % + 4.0 µV 0.013 % + 2.0 µV 0.014 % + 4.0 µV 0.035 % + 8.0 µV 0.078 % + 20 µV	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 µV 0.018 % + 20 µV 0.011 % + 20 µV 0.079 % + 20 µV 0.012 % + 20 µV 0.023 % + 40 µV 0.059 % + 200 µV 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 µV 0.016 % + 120 µV 96 µV/V + 0.2 mV 80 µV/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 µV/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] (±)	Comments
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 µV 0.23 % + 4.0 µV 0.18 % + 4.0 µV 0.23 % + 4.0 µV 0.19 % + 5.0 µV 0.26 % + 10 µV 0.24 % + 20 µV 0.37 % + 20 µV	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 µV 0.03 % + 4.0 µV 0.015 % + 4.0 µV 0.028 % + 4.0 µV 0.058 % + 5.0 µV 0.12 % + 10 µV 0.16 % + 20 µV 0.28 % + 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 500 kHz to 1 MHz	0.025 % + 12 µV 99 µV/V + 7.0 µV 83 µV/V + 7.0 µV 0.021 % + 7.0 µV 0.047 % + 17 µV 0.091 % + 20 µV 0.15 % + 25 µV 0.28 % + 45 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 500 kHz to 1 MHz	0.026 % + 40 µV 97 µV/V + 15 µV 50 µV/V + 8.0 µV 82 µV/V + 10 µV 0.012 % + 30 µV 0.044 % + 80 µV 0.11 % + 200 µV 0.18 % + 300 µV	
(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	

Parameter/Range	Frequency	CMC[2, 5] (±)	Comments
AC Voltage[3] – Generate (cont)			
(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	Fluke 5720A
(220 to 1100) V	(15 to 50) Hz 50 Hz to 1 kHz	0.031 % + 16 mV 77 µV/V + 3.5 mV	Fluke 5720A
	(1 to 5) kHz (5 to 10) kHz	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	
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	

Parameter/Equipment	Range	CMC[2] (±)	Comments
Electrical Calibration of Thermocouple Indicators[3] – (cont)			
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	Fluke 5520A
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	

VI. Fluid Quantities

Parameter/Equipment	Range	CMC[2] (±)	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] (±)	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 µg/g 0.12 lb 0.59 lb	Verification with Class 1, 4 & F weights
Tachometers – Contact Non-Contact	 Up to 40 000 RPM Up to 200 000 RPM	 0.02 % 0.012 %	 Tachometer calibrator Universal counter
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*R* lbf	Load cells & precision weights
Torque – Laboratory: Transducers Tools On-Site:[3] Transducers Tools	 Up to 1000 lbf·ft (0 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

Parameter/Equipment	Range	CMC[2, 6] (±)	Comments
Accelerometers[3] –			
Sensitivity	159.15 Hz	0.14 mV/g	B&K 4294
Frequency Response	Up to 15 kHz (> 15 to 20) kHz	0.25 dB 0.43 dB	Back to back comparison to reference accelerometer
Indirect Verification of Brinell Hardness Testers at Test Conditions[3, 8] –			Indirect verification per ASTM E10
HBW 10/500/15	(50 to 130) HBW	0.04*d* HBW	*d* is the mean of the *n* mean test diameters in millimeters
HBW 10/1000/15	(90 to 140) HBW	0.04*d* HBW	CMC is stated as a percentage of the standardized test block hardness value
HBW 10/3000/15	(200 to 350) HBW	0.04*d* HBW	
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	

Parameter/Equipment	Range	CMC[2] (±)	Comments
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 HR15TW: Low Medium High HR30TW: Low Medium High HR45TW: 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 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

Parameter/Equipment	Range	CMC[2] (±)	Comments
Direct Verification of Durometers –			Direct verification per ASTM D2240
Verification of Indenter Shape & Extension:			
Extension at Zero Reading	---	1.0 µm	
Types A & C			
35 Right Circular Conical Frustum	Diameter of the base of the frustum	6.0 µm	The dimensional characteristics of the indenters are verified by optical projection
	Diameter of the top of the frustum	6.0 µm	
	Cone angle	0.06°	
Verification of Indenter Shape & Extension:			
Types B, D, & M	Diameter of the base of the cone	6.0 µm	
	Cone angle	0.06°	
	Tip radius	6.0 µm	
Types DO, O, & OO	Indenter thickness	6.0 µm	
	Indenter radius	6.0 µm	
Verification of the Durometer Spring	---	42 mN	The durometer spring is verified with Durocalibrator. The CMC applies to all durometer types

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 Fluke 4181
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] (±)	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 µHz + 0.12 µHz/Hz 1.0 mHz + 11 mHz/MHz	Function generator, signal generator, frequency counter or spectrum analyzer with ext. GPS timebase
Stopwatches	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.

[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*.

Accredited Laboratory

A2LA has accredited

QUALITY CALIBRATION SERVICE, INC.

New Berlin, WI

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/NCSLI 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*).

American Association for Laboratory Accreditation
CORPORATE SEAL 1978
DISTRICT OF COLUMBIA
A2LA

Presented this 26th day of September 2022.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 462.01
Valid to May 31, 2024

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