

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

QUALITY CALIBRATION SERVICE, INC.
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CALIBRATION

Valid To: February 29, 2012

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 inspections¹:

I. Acoustical Quantities

Parameter/Equipment	Range	CMC ² (±)	Comments
Sound Level ³ –	(94, 104 & 114) dB (31.5 to 16 000) Hz	0.5 dB	B&K 4226
Fixed Points	94 dB (125 to 2000) Hz	0.7 dB	GenRad 1562
Microphones ³ –			
Sensitivity	250 Hz reference	0.17 dB	B&K 2035 & 4226
Frequency Response	(31.5 to 16 000) Hz	0.22 dB	

II. Dimensional

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Gage Blocks	Up to 1 in (1 to 4) in (5 to 20) in	(2.9 + 3.2L) μin (3.3 + 3.2L) μin (8.7 + 3.2L) μin	By mechanical comparison

Parameter/Equipment	Range	CMC ^{2,4} (\pm)	Comments
Calipers ^{3,6}	Up to 24 in	(62 + 6.5L) μ in	Gage blocks
Length Bars	Up to 12 in (12 to 18) in (18 to 24) in (24 to 46) in (46 to 80) in	(21 + 3.2L) μ in (23 + 3.2L) μ in (37 + 3.2L) μ in (120 + 3.2L) μ in (230 + 3.2L) μ in	Standard measuring machine
Micrometers ^{3,6}	Up to 24 in	(50 + 6L) μ in	Gage blocks
Indicators ^{3,6}	Up to 0.1 in (0.1 to 6) in	90 μ in (130 + 6.5L) μ in	Indicator calibrator Gage blocks
Height Gages ^{3,6}	(0 to 24) in (24 to 40) in	(100 + 6.5L) μ in (110 + 6.5L) μ in	Gage blocks
Cylindrical Plugs/Rings – Major Dimension Minor Dimension	Up to 7 in (7 to 12) in (0.04 to 1) in (2 to 6) in (7 to 12) in	(7.3 + 3.2L) μ in (18 + 3.2L) μ in 4 μ in (13 + 1.5L) μ in (13 + 3.2L) μ in	Universal comparator Internal comparator ULM
Threaded Plugs/Rings – Functional Diameter Minor Dimension Functional Diameter	(0 to 4) in (4 to 20) in Up to 20 in (0.375 to 4.5) in	(54 + 3.2L) μ in (65 + 3.2L) μ in (130 + 3.2L) μ in (57 + 6.4L) μ in	Standard measuring machine Setting plug gages ULM
Surface Flatness	Up to 2 in	4 μ in	Optical flat, monochromatic light
Surface Finish – Profilometer ⁶ Roughness Specimen	(2 to 250) μ in (2 to 250) μ in	5.7 μ in 3 μ in	Roughness patch Profilometer

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Surface Plate Flatness ³	Up to 24 in (25 to 250) in	(58 + 2.5D) μin (25 + 2.5D) μin	Planekator Electronic level system
Linear Displacement with Laser ³	Up to 40 in (40 to 300) in (300 to 600) in	8.6 μin 10 μin 14 μin	Laser
Optical Comparators ³ – X & Y Axes (Glass Scale) (Other Scales)	Up to 12 in Up to 12 in	200 μin (75 + 6.5L) μin	Glass master and precision balls
Glass Scale Inspection Masters	Up to 24 in	43 μin	Optek video CMM
CMM ³ – Repeatability Linearity Volumetric Bi-Directional	Up to 40 in	62 μin 91 μin 85 μin 55 μin	Test sphere Check master Ball bar Gage block

III. Dimensional Testing/Calibration⁸

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Dimensional Measurements –	Up to 40 in	(120 + 3.2L) μin	CMM (substitution method)
1-D Measurement 2-D Measurement 3-D Measurement	Up to 60 in Up to 48 in Up to 36 in	(320 + 7.2L) μin (560 + 10L) μin (640 + 11L) μin	CMM
1-D measurement 2-D measurement 3-D measurement	Up to 24 in Up to 18 in Up to 6 in	(240 + 3.2L) μin (430 + 3.2L) μin (500 + 3.2L) μin	Video CMM; non-contact measurement

IV. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
DC Current ³ – Measure	(0 to 200) µA 200 µA to 2 mA (2 to 20) mA (20 to 200) mA (0.2 to 2) A	13 µA/A + 0.4 nA 13 µA/A + 4 nA 15 µA/A + 40 nA 50 µA/A + 0.8 µA 0.019 % + 16 µA	Fluke 8508A
	(2 to 20) A	0.04 % + 400 µA	
	(2 to 150) A	0.1 % of reading	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	42 µA/A + 6 nA 37 µA/A + 7 nA 40 µA/A + 40 nA 46 µA/A + 0.7 µA 83 µA/A + 12 µA	Fluke 5720A
	(2.2 to 3) A (3 to 11) A	0.039 % + 40 µA 0.051 % + 0.5 mA	Fluke 5520A
	(11 to 20.5) A	0.11 % + 0.75 mA	
	(20.5 to 1000) A	0.84 % + 0.5 mA	Fluke 50 turn coil, clamp ons
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 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

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

Parameter/Range	Frequency	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	10 Hz to 10 kHz 10 Hz to 10 kHz 10 Hz to 3 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz (0 to 50) Hz (0 to 20) Hz (0 to 6) Hz (0 to 2) Hz (0 to 0.6) Hz (0 to 0.2) Hz	0.51 % + 0.01 nF 0.51 % + 0.01 nF 0.51 % + 0.01 nF 0.25 % + 0.01 nF 0.25 % + 0.10 nF 0.25 % + 0.10 nF 0.25 % + 0.3 nF 0.25 % + 1.0 nF 0.25 % + 3.0 nF 0.25 % + 10 nF 0.40 % + 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
AC Current³ – Measure Up to 200 μA 200 μA to 2 mA (2 to 20) mA (20 to 200) mA (0.2 to 2) A	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz (1 to 10) Hz 10 Hz to 30 kHz (30 to 100) kHz 10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz	0.051 % + 20 nA 0.051 % + 20 nA 0.074 % + 20 nA 0.4 % + 20 nA 0.032 % + 0.2 μA 0.031 % + 0.2 μA 0.072 % + 0.2 μA 0.4 % + 0.2 μA 0.032 % + 2 μA 0.031 % + 2 μA 0.072 % + 2 μA 0.4 % + 2 μA 0.032 % + 20 μA 0.030 % + 20 μA 0.063 % + 20 μA 0.063 % + 200 μA 0.063 % + 200 μA 0.074 % + 200 μA	Fluke 8508A

Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
AC Current ³ – Measure (cont)			
(2 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	0.083 % + 2 mA 0.26 % + 2 mA	Fluke 8508A
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 nA 0.033 % + 12 nA 0.12 % + 65 nA	Fluke 5720A
(0.22 to 2.2) mA	(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
(2.2 to 22) mA	(10 to 30) kHz	0.4 % + 500 nA	Fluke 5520A
(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 µA	Fluke 5720A
(22 to 220) mA	(10 to 30) kHz	0.40 % + 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	0.028 % + 4 µA 0.018 % + 3.5 µA 0.013 % + 2.5 µA 0.021 % + 3.5 µA 0.12 % + 10 µA	Fluke 5720A
(0.22 to 2.2) A	(10 to 30) kHz	0.4 % + 200 µA	Fluke 5520A
(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	Fluke 5720A
(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 mA 2.5 % + 5 mA	Fluke 5520A

Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
AC Current ³ – Generate (cont)			
(2.9 to 11) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.17 % + 2 mA 0.11 % + 2 mA 0.11 % + 2 mA	Fluke 5520A
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.13 % + 2 mA 0.15 % + 5 mA 3.0 % + 5 mA	
(20.5 to 1000) A	(45 to 65) Hz (65 to 440) Hz	0.73 % 1.3 %	Fluke 50 turn coil, clamp ons
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	0.017 % + 14 μV 0.015 % + 4 μV 0.012 % + 4 μV 0.013 % + 2 μV 0.014 % + 4 μV 0.035 % + 8 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	0.018 % + 120 μV 0.013 % + 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 mV 1 % + 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	0.016 % + 1.2 mV 0.012 % + 0.2 mV 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 mV 0.3 % + 20 mV 1 % + 200 mV	

Parameter/Range	Frequency	CMC ^{2.5} (\pm)	Comments
AC Voltage ³ – Measure (cont)			
(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	0.018 % + 12 mV 0.013 % + 2 mV 0.011 % + 2 mV 85 μ V/V + 2 mV 0.012 % + 2 mV 0.023 % + 4 mV 0.058 % + 20 mV 0.3 % + 200 mV 1 % + 2 V	Fluke 8508A
(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	0.016 % + 70 mV 0.014 % + 20 mV 0.012 % + 20 mV 0.023 % + 40 mV 0.059 % + 70 mV	
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 μ V 0.23 % + 4 μ V 0.18 % + 4 μ V 0.23 % + 4 μ V 0.19 % + 5 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 μ V 0.03 % + 4 μ V 0.015 % + 4 μ V 0.028 % + 4 μ V 0.058 % + 5 μ V 0.12 % + 10 μ V 0.16 % + 20 μ V 0.28 % + 20 μ V	

Parameter/Range	Frequency	CMC ^{2.5} (\pm)	Comments
AC Voltage ³ – Generate (cont)			
(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 μ V 83 μ V/V + 7 μ V 0.021 % + 7 μ V 0.047 % + 17 μ V 0.091 % + 20 μ V 0.15 % + 25 μ V 0.28 % + 45 μ V	Fluke 5720A
(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 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	
(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 μ V 97 μ V/V + 150 μ V 50 μ V/V + 50 μ V 81 μ V/V + 100 μ V 0.011 % + 200 μ V 0.03 % + 600 μ V 0.11 % + 2 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 μ V/V + 1.5 mV 56 μ V/V + 0.6 mV 91 μ V/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 μ V/V + 3.5 mV 0.026 % + 10 mV 0.031 % + 10 mV	Fluke 5520A

Parameter/Equipment	Range	CMC ² (±)	Comments
Thermocouple Reference Junction	0 °C	0.071 °C	Using TRP reference probes and Kaye Instruments K140-4

IV. Mechanical

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Mass ⁶	1 mg to 100 g 100 g to 3 kg (3 to 25) kg	0.19 mg 0.25 g 0.62 g	Comparison to standard weights, class 4, 6, & F weights only
Scales & Balances ^{3,6}	1 g to 3 kg (3.1 to 25) kg (50 to 1000) lb (1001 to 5000) lb	0.048 g 0.63 g 0.13 lb 0.61 lb	Verification with class 1, 4 and F weights
Tachometers	Up to 40 000 rpm	0.03 %	Tachometer calibrator
Pressure Gauges and Transducers ^{3,6}	(-13 to 300) psi (300 to 10 000) psi	0.1 % 0.1 %	Electronic pressure tester Dead weight tester
Force – Load Cells, Compression and Tension Testing Machines ^{3,6}	Up to 50 000 lbf	0.2 %	Load cells and precision weights
Torque ⁶ – Laboratory Transducers Tools On-Site ³ Transducers Tools	 Up to 1000 ft·lb (0 to 2000) ft·lb Up to 250 ft·lb Up to 1000 ft·lb	 0.66 % 1.1 % 0.75 % 1.1 %	 Weight and torque arm torque transducer

Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Rockwell and Rockwell Superficial Hardness Testers ³	HRA:		Indirect verification per ASTM E18
	Low	1 HRA	
	Middle	0.8 HRA	
	High	0.8 HRA	
	HRB:		
	Low	1.1 HRB	
	Middle	1.1 HRB	
	High	1.1 HRB	
	HRC:		
	Low	0.7 HRC	
	Middle	0.7 HRC	
	High	0.6 HRC	
	HRF:		
	Low	1.4 HRF	
Middle	1.4 HRF		
High	1.1 HRF		
HR15N:			
Low	1.3 HR15N		
Middle	1.2 HR15N		
High	1.2 HR15N		
HR30N:			
Low	1.4 HR30N		
Middle	1.5 HR30N		
High	1.2 HR30N		
HR45N:			
Low	1 HR45N		
Middle	1 HR45N		
High	1 HR45N		
HR15T:			
Low	0.9 HR15T		
Middle	1 HR15T		
High	1 HR15T		
HR30T:			
Low	1.6 HR30T		
Middle	1.4 HR30T		
High	1.4 HR30T		
HR45T:			
Low	1.3 HR45T		
Middle	1 HR45T		
High	1 HR45T		

Parameter/Equipment	Range	CMC ² (±)	Comments
Direct Verification of Durometers ⁶ :			Direct verification per ASTM 2240
Verification of Indenter Shape and Extension:			
Extension at Zero Reading	---	13 µm	
Types A & C			
35 right circular conical frustum	Diameter of the base of the frustum	110 µm	The dimensional characteristics of the indenters are verified by optical projection.
	Diameter of the top of the frustum	110 µm	
	Cone angle	0.13°	
Verification of Indenter Shape and Extension:			
Types B, D, & M			
	Diameter of the base of the cone	110 µm	
	Cone angle	0.13°	
	Tip radius	110 µm	
Types DO, O, & OO			
	Indenter thickness	110 µm	
	Indenter radius	110 µm	
Verification of the Durometer Spring	---	15 mN	The durometer spring is verified with dead weights. The CMC applies to all durometer types.

V. Thermodynamics

Parameter/Equipment	Range	CMC ² (±)	Comments
Temperature ³	(-25 to 932) °F	0.072 °F	Hart reference SPRT
Infrared Thermometers ³	(50 to 500) °C	0.94 °C	Hart IR calibrator
Relative Humidity	(0 to 90) % RH	1.4 % RH	Vaisala HMP141

VI. Time & Frequency

Parameter	Range	CMC ² (±)	Comments
Frequency ³ – Fixed Point	10 MHz	1×10^{-10} Hz/Hz	GPS system
Measure	0.01 Hz to 100 MHz	2.5×10^{-6} Hz/Hz + 5 µHz	HP 5334B

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

² Calibration and Measurement Capability (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. Calibration and Measurement Capabilities represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of $k = 2$. The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

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 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.

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 These calibrations are performed at Quality Calibration Repair Center, located at: 6857 W. Beloit Road West Allis, WI 53219

⁷ In the statement of CMC, percentages are to be read as percent of reading, unless otherwise noted.

⁸ 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.