



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

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CALIBRATION

Valid To: April 30, 2018

Certificate Number: 1888.03

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 Measuring Equipment ³	94 dB	0.5 dB	Extech 407766
	114 dB	0.62 dB	General Radio 1562A

II. Chemical

Parameter/Equipment	Range	CMC ² (±)	Comments
pH Measuring Equipment ³	(4, 7, 10) pH	0.02 pH	pH buffer solutions

Parameter/Equipment	Range	CMC ² (±)	Comments
Conductivity ³ –			
Liquid	1015 µS 1408 µS 12 850 µS 111 300 µS	11 µS 15 µS 90 µS 1200 µS	Conductivity solutions
Solid	8.4 % IACS 30 % IACS 48 % IACS 100 % IACS	1.5 % of value 1.5 % of value 0.50 % IACS 0.85 % IACS	Z-Tech conductivity standard blocks

III. Dimensional

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Gage Blocks	Up to 1 in 2 in 3 in 4 in 5 in 6 in 7 in 8 in 10 in 12 in 16 in 20 in	3.3 µin 4.2 µin 5.4 µin 6.7 µin 8.5 µin 10 µin 12 µin 13 µin 16 µin 19 µin 25 µin 32 µin	By mechanical comparison
Calipers ³	Up to 80 in	(350 + 13L) µin	Gage blocks
Micrometers ³	Up to 80 in	(67 + 8.5L) µin	Gage blocks
Height Gages ³	Up to 80 in	(120 + 8L) µin	Gage blocks
Bore Micrometers and Countersink Gages ³	Up to 6 in	(90 + 12L) µin + 0.58R	Ring gages

Parameter/Equipment	Range	CMC ^{2,4} (\pm)	Comments
Dial, Digital, Test, Bore & Co-Axial Indicators ³	Up to 12 in	$(26 + 4L) \mu\text{in} + 0.58R$	Gage blocks
Rigid Rulers ³	Up to 80 in	0.004 in	Digital length scale
Tape Measures & Pi-Tapes ³	Up to 100 ft	0.004 in per 6 ft	Digital length scale
Digital Length Scales ³	Up to 80 in	$100 \mu\text{in} + 1.3L$	Gage blocks and LVDT
Coating Thickness Gages ³	Up to 665 mils	$(0.035 + 0.01M) \text{ mils} + 0.58R$	Master foils M =nominal thickness in mils
Ultrasonic Thickness Gages ³	Up to 10 in	$200 \mu\text{in} + 0.58R$	Gage blocks
Cylindricals – Inside/Outside Diameter	Up to 1 in (1 to 2) in (2 to 4) in (4 to 8) in (8 to 12) in	11 μin 12 μin 15 μin 23 μin 32 μin	Labmaster universal
Outside Diameter ³	Up to 10 in	41 μin	P&W Supermicrometer ^{TM, 6}
Thread Gages – Simple Pitch Diameter			
Outside Diameter	Up to 7.5 in	100 μin	Labmaster universal
Inside Diameter	Up to 6 in	120 μin	
Thread Gages – Simple Pitch Diameter ³	Up to 10 in	100 μin	P&W Supermicrometer ^{TM, 6}

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Thread Wires	(2 to 100) TPI	20 μin	Labmaster universal
Feeler Gages ³	Up to 1 in	110 μin	OD micrometer
Radius Gages	Up to 5 in	250 μin	Vision machine
Screw Pitch Gages	(3½ to 84) TPI	350 μin	Vision machine
Indicator Testers	Up to 4 in	(27 + 3L) μin	Gage blocks
Depth Mic Masters	Up to 24 in	(15 + 2.5L) μin	Linear height gage, gage blocks
Mike Masters/Kal Masters	Up to 12 in	(5 + 13L) μin	Labmaster
Micrometer Standards	Up to 12 in (>12 to 60) in (>60 to 100) in	(27 + 2L) μin (100 + 4L) μin (210 + 4L) μin	Labmaster universal CMM CMM
V-Blocks – Parallelism V Height Angle Perpendicularity	Up to 36 in Up to 36 in Up to 36 in Up to 36 in	(110 + 4L) μin (110 + 4L) μin 0.0008° (110 + 4L) μin	CMM
Straight Edges – Flatness	Up to 100 in	250 μin	CMM
Parallels	Up to 100 in	70 μin	CMM & linear height gage

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Sine Bars & Plates – Flatness Distance between rolls	Up to 36 in Up to 36 in	100 μin (90 + 5L) μin	CMM
Squares and Angle Plates – Angle Flatness Perpendicularity	Up to 36 in Up to 36 in Up to 36 in	0.0006° 160 μin (110 + 4L) μin	CMM
Glass Scales, Stage Micrometers & Reticules	Up to 12 in	(150 + 8L) μin	Vision machine
Angle Standards	Up to to 360°	0.0008°	CMM
Surface Finish Testers ³	(5 to 125) μin	5.2 μin + 0.58R	Master surface finish standard
Bubble Levels	Up to 48 in	300 μin	Gage blocks
Surface Finish Standards (Specimens) ³	(5 to 250) μin	5.2 μin	Master surface finish standard
Testing Sieves	(5 to 225) #	150 μin	Vision machine
Surface Plate ³ – Flatness Repeat Reading	12 in × 12 in to 12 ft × 12 ft 12 in × 12 in to 12 ft × 12 ft	(6 + 1.7DL) μin 34 μin	Electronic level system DL=diagonal distance Repeat-o-meter

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Optical Comparator and Vision Machines ³ – X-Y Linearity	Up to 6 in	280 μin + 0.58R	Glass master
Crimp Tools ³	Go/no go Crimp height Pullout	0.001 in 640 μin 3.5 lbf	Pin gages Crimp micrometer Crimp pull tester
Protractors ³	Up to 90°	0.044°	Angle blocks
	Up to 65°	0.030°	Sine plate & gage blocks

IV. Dimensional Testing¹

Parameter	Range	CMC ^{2,4} (±)	Technique/Method
Geometry Measurements ⁸	27 in × 39 in × 27 in Linear Volumetric	90 μin 130 μin	Coordinate measuring machine (CMM), ASME Y 14.5
	47 in × 118 in × 39 in Linear Volumetric	240 μin 520 μin	Coordinate measuring machine (CMM), ASME Y 14.5
	12 in × 12 in × 8 in Linear Angular	230 μin 0.0014°	Vision system, ASME Y 14.5
	32 in × 54 in × 29 in Linear Volumetric	100 μin 170 μin	Coordinate measuring machine (CMM), ASME Y 14.5
	Up to 24 in	(160 + 9L) μin	Linear height gage
	Up to 1 in	110 μin	O.D. Micrometer
Surface Finish ⁷	(5 to 125) μin	5.2 μin	Master surface finish standard

V. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 5, 10} (±)	Comments
DC Voltage – Generate ³	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 (1 to 50) kV	8.9 μV/V + 0.8 μV 8 μV/V + 1.2 μV 8 μV/V + 4 μV 8 μV/V + 8 μV 9 μV/V + 100 μV 11 μV/V + 600 μV 0.15 %	Fluke 5700A Ross VD60-2
DC Voltage – Measure ³	(0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1000) V (1 to 60) kV (60 to 240) kV	10 μV/V + 3 μV 9 μV/V + 3 μV 9 μV/V + 5 μV 11 μV/V + 30 μV 11 μV/V + 100 μV 0.15 % 1.5 %	Agilent 3458A Ross VD60-2 Ross VPM 240
DC Current – Generate ³	(0 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 11) A (11 to 20.5) A (2 to 20) A (20 to 120) A (120 to 3000) A	060 μA/A + 10 nA 60 μA/A + 10 nA 41 μA/A + 100 nA 70 μA/A + 1 μA 95 μA/A + 30 μA 0.038 % + 480 μA 0.1 % + 750 μA 90 μA/A + 0.1mA 80 μA/A + 8 mA 0.8 % + 0.08 A	Fluke 5700A Fluke 5522A Fluke 52120A/coil
DC Current – Measure ³	(10 to 100) μA 100 μA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A (1 to 3) A (3 to 300) A 300 A to 2 kA (2 to 10) kA	22 μA/A + 1 nA 22 μA/A + 5 nA 22 μA/A + 50 nA 37 μA/A + 0.5 nA 0.012 % + 10 μA 0.13 % + 0.6mA 0.013 % 0.25 % 1.0 %	Agilent 3458A Agilent 34401A Guildline 9711A Empro shunts



Parameter/Equipment	Range	CMC ^{2, 5, 10} (±)	Comments
Resistance – Measure ³	(0 to 10) Ω (10 to 100) Ω (100 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1 GΩ	20 μΩ/Ω + 5 μΩ 15 μΩ/Ω + 5 μΩ 13 μΩ/Ω + 5 μΩ 18 μΩ/Ω + 2 Ω 50 μΩ/Ω + 100 Ω 0.06 % + 1 kΩ 0.5 % + 10 kΩ	Agilent 3458A
Capacitance – Generate ³	(0.19 to 3.3) nF (3.3 to 330) nF 330 nF to 3.3 μF (3.3 to 33) μF (33 to 330) μF 330 μF to 3.3 mF (3.3 to 33) mF (33 to 110) mF	0.5 % + 0.01 nF 0.25 % + 0.3 nF 0.20 % + 3 nF 0.40 % + 30 nF 0.45 % + 300 nF 0.45 % + 3 μF 0.75 % + 30 μF 0.66 % + 100 μF	Fluke 5522A
Capacitance – Generate ³	(10 to 1.1) μF (50 to 1100) μF	0.07 % 1.8 %	Quad Tech 1413 GR 1422-CB air cap
Fixed Points ³	(0.001, 0.01, 0.1) μF 1 μF	0.16 %	GR 1409 series
Capacitance – Measure, at 1 kHz ³	(10 to 1120) μF	0.27 %	GR 1689

Parameter/Range	Frequency	CMC ^{2, 5, 10} (±)	Comments
Inductance – Generate ³			
1.0 mH 1 mH	400 Hz 1 kHz	0.12 % 0.12 %	GR 1482-E
10.0 mH 100 mH	1 kHz 1 kHz	0.10 % 0.10 %	GR1482-H GR1482-L



Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Inductance – Measure, at 1 kHz ³	1 μH to 100 H	0.27 %	GR 1689
Electrical Calibration of Thermocouple Indicators ³ –			
Type B	600 °C to 800 °C 800 °C to 1000 °C 1000 °C to 1550 °C 1550 °C to 1800 °C	0.49 °C 0.40 °C 0.36 °C 0.31 °C	Fluke 5522A
Type C	0 °C to 150 °C 150 °C to 650 °C 650 °C to 1000 °C 1000 °C to 1800 °C 1800 °C to 2316 °C	0.28 °C 0.23 °C 0.28 °C 0.45 °C 0.73 °C	
Type E	-250 °C to -100 °C -100 °C to -25 °C -25 °C to 350 °C 350 °C to 650 °C 650 °C to 1000 °C	0.05 °C 0.15 °C 0.13 °C 0.16 °C 0.20 °C	
Type J	-210 °C to -100 °C -100 °C to -30 °C -30 °C to 150 °C 150 °C to 760 °C 760 °C to 1200 °C	0.32 °C 0.15 °C 0.13 °C 0.17 °C 0.22 °C	
Type K	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 1000 °C 1000 °C to 1372 °C	0.30 °C 0.17 °C 0.15 °C 0.23 °C 0.35 °C	



Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of Thermocouple Indicators ³ – (cont)			
Type L	-200 °C to -100 °C -100 °C to 800 °C 800 °C to 900 °C	0.43 °C 0.31 °C 0.20 °C	Fluke 5522A
Type N	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 410 °C 410 °C to 1300 °C	0.36 °C 0.20 °C 0.18 °C 0.17 °C 0.25 °C	
Type R	0 °C to 250 °C 250 °C to 400 °C 400 °C to 1000 °C 1000 °C to 1767 °C	0.56 °C 0.33 °C 0.31 °C 0.36 °C	
Type S	0 °C to 250 °C 250 °C to 1000 °C 1000 °C to 1400 °C 1400 °C to 1767 °C	0.55 °C 0.35 °C 0.33 °C 0.40 °C	
Type T	-250 °C to -150 °C -150 °C to 0 °C 0 °C to 120 °C 120 °C to 400 °C	0.56 °C 0.22 °C 0.15 °C 0.13 °C	
Type U	-200 °C to 0 °C 0 °C to 600 °C	0.65 °C 0.32 °C	



Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of RTDs ³ –			
Pt 385, 100 Ω	-200 °C to 0 °C 0 °C to 100 °C 100 °C to 300 °C 300 °C to 630 °C 630 °C to 800 °C	0.063 °C 0.083 °C 0.1 °C 0.12 °C 0.25 °C	Fluke 5522A
Pt 3926, 100 Ω	-200 °C to 0 °C 0 °C to 300 °C 300 °C to 630 °C	0.06 °C 0.1 °C 0.12 °C	
Pt 3916, 100 Ω	-200 °C to -190 °C -190 °C to 0 °C 0 °C to 260 °C 260 °C to 600 °C 600 °C to 630 °C	0.29 °C 0.07 °C 0.08 °C 0.1 °C 0.27 °C	
Pt 385, 200 Ω	-200 °C to 260 °C 260 °C to 630 °C	0.06 °C 0.17 °C	
Pt 385, 500 Ω	-200 °C to 260 °C 260 °C to 400 °C 400 °C to 630 °C	0.06 °C 0.09 °C 0.11 °C	
Pt 385, 1000 Ω	-200 °C to 260 °C 260 °C to 600 °C 600 °C to 630 °C	0.05 °C 0.08 °C 0.26 °C	
Ni 120, 120 Ω	-80 °C to 100 °C 100 °C to 260 °C	0.09 °C 0.16 °C	
Cu 427 10 Ω	-100 °C to 260 °C	0.35 °C	



Parameter/Range	Frequency	CMC ^{2, 5, 10} (±)	Comments
AC Voltage – Generate ³			
(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	0.06 % + 5 μV 0.024 % + 5 μV 0.012 % + 5 μV 0.041 % + 5 μV 0.095 % + 8 μV 0.13 % + 15 μV 0.18 % + 30 μV 0.36 % + 30 μV	Fluke 5700A
(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	0.06 % + 6 μV 0.024 % + 6 μV 0.012 % + 6 μV 0.041 % + 6 μV 0.095 % + 8 μV 0.13 % + 15 μV 0.18 % + 30 μV 0.36 % + 30 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	0.06 % + 16 μV 0.024 % + 10 μV 0.011 % + 10 μV 0.036 % + 10 μV 0.090 % + 30 μV 0.11 % + 30 μV 0.18 % + 40 μV 0.36 % + 100 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 (0.5 to 1) MHz	0.06 % + 100 μV 0.018 % + 30 μV 0.085 % + 7 μV 0.014 % + 20 μV 0.028 % + 80 μV 0.048 % + 150 μV 0.12 % + 400 μV 0.24 % + 1mV	
(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	0.06 % + 1.0 mV 0.018 % + 0.3 mV 0.0085 % + 0.07mV 0.040% + 0.2mV 0.028 % + 0.4mV 0.06 % + 1.7 mV 0.14 % + 5 mV 0.30 % + 9 mV	

Parameter/Range	Frequency	CMC ^{2, 5, 10} (±)	Comments
AC Voltage – Generate ³ (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 (100 to 300) kHz (300 to 500) kHz	0.06 % + 10 mV 0.018 % + 3 mV 0.009 % + 1 mV 0.025 % + 4 mV 0.06 % + 10 mV 0.16 % + 110 mV 0.44 % + 110 mV	Fluke 5700A w/5725A
(220 to 1100) V	40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz (20 to 50) kHz (50 to 100) kHz	0.009 % + 4 mV 0.0165 % + 6mV 0.060 % + 11mV 0.060 % + 11mV 0.23 % + 45 mV	Ross VD60-2
(1 to 50) kV	60 Hz	0.58 %	
AC Voltage – Measure ³			
(1 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	0.031 % rdg + 0.03 % rng 0.021 % rdg + 0.01 % rng 0.031 % rdg + 0.01 % rng 0.011 % rdg + 0.01 % rng 0.51 % rdg + 0.01 % rng 4.1 % rdg + 0.02 % rng	Agilent 3458A
(10 to 100) mV, 100 mV to 1 V, (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 300 kHz to 1 MHz (1 to 2) MHz	0.008 % rdg + 0.005 % rng 0.008 % rdg + 0.002 % rng 0.015 % rdg + 0.002 % rng 0.031 % rdg + 0.002 % rng 0.081 % rdg + 0.002 % rng 0.031 % rdg + 0.01 % rng 2.0 % rdg + 0.01 % rng 2.0 % rdg + 0.01 % rng	



Parameter/Range	Frequency	CMC ^{2,5,10} (±)	Comments
AC Voltage – Measure ³			
(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 (100 to 300) kHz 300 kHz to 1 MHz	0.021 % rdg + 0.004 % rng 0.021 % rdg + 0.002 % rng 0.021 % rdg + 0.002 % rng 0.036 % rdg + 0.002 % rng 0.13 % rdg + 0.002 % rng 0.41 % rdg + 0.013 % rng 1.8 % rdg + 0.01 % rng	
(100 to 1000) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.041 % rdg + 0.004 % rng 0.041 % rdg + 0.002 % rng 0.061 % rdg + 0.002 % rng 0.13 % rdg + 0.002 % rng 0.31 % rdg + 0.002 % rng	
(1 to 42) kV	60 Hz	0.58 %	Ross VD60-2
(42 to 170) kV	60 Hz	1.2 %	Ross VPM 240
AC Current – Generate ³			
(0 to 220) μA	(10 to 20) Hz (20 to 40) Hz (0.40 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.08 % rdg + 30 nA 0.042 % rdg + 25 nA 0.016 % rdg + 20 nA 0.07 % rdg + 50 nA 0.18 % rdg + 100 nA	Fluke 5700
220 μA to 2.2 mA	(10 to 20) Hz (20 to 40) Hz (0.40 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.08 % rdg + 50 nA 0.042 % rdg + 40 nA 0.016 % rdg + 40 nA 0.07 % rdg + 0.5 μA 0.18 % rdg + 1 μA	
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz (0.40 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.08 % rdg + 0.5 μA 0.042 % rdg + 0.4 μA 0.016 % rdg + 0.4 μA 0.07 % rdg + 5 μA 0.18 % rdg + 10 μA	



Parameter/Range	Frequency	CMC ^{2, 5, 10} (±)	Comments
AC Current – Generate ³			
(22 to 220) mA	(10 to 20) Hz (20 to 40) Hz (0.40 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.08 % rdg + 5 µA 0.042 % rdg + 4 µA 0.018 % rdg + 4 µA 0.07 % rdg + 4 µA 0.18 % rdg + 100 µA	Fluke 5700
220 mA to 2.2 A	(40 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.075 % rdg + 40 µA 0.085 % rdg + 100µA 1.0 % rdg + 200 µA	
(2.2 to 11) A	(40 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.75 % rdg + 0.04 mA 0.85 % rdg + 0.1 mA 1.0 % rdg + 0.2 mA	
(11 to 20.5) A	(45 to 100) Hz (0.1 to 5) kHz	1.0 % rdg + 500 mA 2.5 % rdg + 500 mA	Fluke 5522A
(20.5 to 120) A	(10 to 65) Hz (65 to 300) Hz (0.3 to 1.0) kHz (1 to 3) kHz (3 to 6) kHz (6 to 10) kHz	0.014 % + 19 mA 0.024 % + 28 mA 0.078 % + 94 mA 0.23 % + 230 mA 0.76 % + 420 mA 3.1 % + 700 mA	Fluke 52120A
(20.5 to 3000) A	(16 to 850) Hz (0.85 to 6) kHz	0.7 % + 0.84A 0.8 % + 0.84A	Fluke 52120A/coil
Clamp-on only (20.5 to 1025) A	(45 to 65) Hz (65 to 440) Hz	0.8 % 0.99 %	Fluke 5522A w/Fluke 50-turn coil

Parameter/Range	Frequency	CMC ^{2, 5, 10} (±)	Comments
AC Current – Measure ³			
(5 to 100) μA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 5 kHz	0.45 % rdg + 0.03 % rng 0.18 % rdg + 0.03 % rng 0.8 % rdg + 0.03 % rng	Agilent 3458A
(1, 10, 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.41 % rdg + 0.02 % rng 0.16 % rdg + 0.02 % rng 0.07 % rdg + 0.02 % rng 0.04 % rdg + 0.02 % rng 0.4 % rdg + 0.04 % rng 0.42 % rdg + 0.04 % rng 0.56 % rdg + 0.16 % rng	Agilent 3458A
1 A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz	0.42 % rdg + 0.02 % rng 0.16 % rdg + 0.02 % rng 0.10 % rdg + 0.02 % rng 0.12 % rdg + 0.02 % rng 0.35 % rdg + 0.02 % rng 0.35 % rdg + 0.02 % rng	Agilent 3458A
3 A	(3 to 5) Hz (5 to 10) Hz 10 Hz to 5 kHz	1.2 % rdg + 0.06 % rng 0.37 % rdg + 0.06 % rng 0.17 % rdg + 0.06 % rng	HP 34401A
3 A to 1 kA	45 Hz to 5 kHz	0.8 %	AEMC clamp-on meter
(1 to 10) kA	10 Hz to 20 kHz	1.0 % + 3 A	AEMC Flex Clamp
AC Power – Generate ³			
(0.01 to 0.1) W (0.1 to 890) W (0.89 to 3) kW (3 to 20.5) kW	(45 to 65) Hz; PF = 1	0.23 % 0.13 % 0.13 % 0.13 %	Fluke 5522A

Parameter/Range	Frequency	CMC ^{2, 5, 10} (±)	Comments
Oscilloscopes ³			
DC			
50 Ω	(0 to +/- 6.6) V	0.26 % + 40 μV	Fluke 5522A/SC1100
1 M Ω	(0 to +/- 130) V	0.06 % + 40 μV	
Square Wave			
50 Ω	(0 to +/- 6.6) V	0.26 % + 40 μV	
1 M Ω	(0 to +/- 130) V	0.2 % + 40 μV	
Level Sine Wave			
Amplitude (50 kHz Reference)	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1100) MHz	2.0 % + 300 μV 2.5 % + 300 μV 5.0 % + 300 μV 6.0 % + 300 μV	
Flatness (50 kHz Reference)	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1100) MHz	2.0 % + 100 μV 3.0 % + 100 μV 5.0 % + 100 μV 6.0 % + 100 μV	
Time Marker	1 ns to 20 ms 50 ms to 5 s	3 μs/s (30 + 1000t) μs/s	t = time in seconds

VI. Fluid Quantities

Parameter/Equipment	Range	CMC ² (±)	Comments
Gas Flow – Nitrogen Gas	(50 to 1000) sccm (3 to 50) slm (10 to 120) slm (45 to 600) slm	0.2 % rdg + 0.002 sccm 0.2 % rdg + 0.002 slm 0.2 % rdg 0.2 % rdg	Molbox1, Druck DP1740

VII. Magnetic Quantities

Parameter/Equipment	Range	CMC ² (±)	Comments
Magnetic Flux Density – Fixed Points ³	-2.0 G 2.0 G -5.0 G 5.0 G -10 G 10 G 20 G -20 G 50 G 100 G 500 G 1000 G	0.087 G 0.087 G 0.12 G 0.12 G 0.37 G 0.37 G 0.54 G 0.54 G 0.56 G 1.2 G 6.1 G 12 G	Reference magnets

VIII. Mechanical

Parameter/Equipment	Range	CMC ^{2, 4, 5} (±)	Comments
Accelerometers	(10 to 99) Hz 100 Hz (101 to 920) Hz (921 to 5000) Hz (5000 to 10 000) Hz (10 000 to 15 000) Hz (15 000 to 20 000) Hz	1.5 % 0.98 % 1.2 % 1.5 % 2.0 % 3.4 % 4.6 %	Secondary std. reference and air bearing shaker table.
Universal Testing Machines, Compression Testing Machines and Tension Testing Machines ³	(0.2 to 600) lbf (up to 600 000) lbf	0.04 % + 0.58R 0.4 % + 0.58R	Deadweights load cells; The range for testing machines in tension is only to 60 000 lbf. ASTM E4
Extensometers ³	Up to 2 in	0.00014 in	ASTM E83



Parameter/Equipment	Range	CMC ^{2, 4, 5} (\pm)	Comments
Calibration of Force Gages, Load Cells, Dynamometers & Cable Tensiometers ³	Up to 600 lbf	0.02 % + 0.58R	Comparison to Class F weights
	(0 to 500) lbf	0.3 lbf + 0.58R	Master load cells
	(0 to 1 000) lbf	0.92 lbf + 0.58R	
	(0 to 10 000) lbf	4.0 lbf + 0.58R	
	(0 to 30 000) lbf	13 lbf + 0.58R	
	(0 to 100 000) lbf	40 lbf + 0.58R	
Vacuum Gages and Transducers ³	Up to 28 inHg	0.02 % + 0.58R	DH Instruments PPC2+; gage pressure only, not absolute.
Pressure Gages and Transducers ³ –			
Hydraulic ³	Up to 15 000 psi	0.15 % + 0.58R	Ametek DMT150 deadweight tester
Hydraulic	Up to 40 000 psi	0.05 % + 0.58R	Ruska 580EHX
Pneumatic ³	Up to 1000 psi	0.025 % + 0.58R	DH Instruments PPC2+
Pneumatic ³	Up to 30 psia	0.01 % + 0.58R	DH Instruments PPC3
Pneumatic ³	Up to 3000 psi	0.70 psi + 0.58R	Fluke PM200-G250M Transducer
Torque ³ –			
Wrenches	20 in·ozf to 2000 ft·lbf	0.8 %	CDI Datatest 950-DT
Analyzers	(0 to 24 000) in·lbf	0.10 % + 0.58R	Torque arm/wheel w/ deadweights
RPM ³ – Measure	(0 to 4999.9) RPM (5000 to 7999.9) RPM (8000 to 9999.9) RPM (10 000 to 35 000) RPM	0.02 % + 0.1 RPM 0.02 % + 0.2 RPM 0.02 % + 0.5 RPM 0.02 % + 1.0 RPM	Laser tachometer



Parameter/Equipment	Range	CMC ^{2, 4, 5} (\pm)	Comments
Torque ³ – Guns, Drivers, Screwdrivers	(0 to 250) Nm	0.40 % + 0.58R	Crane and Norbar torque transducers
Calibration of Mass	(1, 2, 5, 10, 20) mg (50, 100, 200, 500) mg (1, 2, 5, 10, 20) g (50, 100, 200) g 500 g 1 kg 2 kg (5, 10) kg 20 kg (1, 2) lb 5 lb (10, 20) lb 50 lb 100 lb	8 μ g 8 μ g 8 μ g 0.18 mg 0.29 mg 0.52 mg 1.0 mg 8.0 mg 12 mg 0.35 mg 1.0 mg 8 mg 300 mg 450 mg	Comparison to Class 1 weights Comparison to Class F weights
Calibration of Scales and Balances ³	(1, 2, 5, 10, 20) mg (50, 100, 200, 500) mg (1, 2, 5) g (10, 20) g 50 g to 10 kg (1 to 20) lb (1 to 1200) lb	30 μ g + 0.58R 30 μ g + 0.58R 50 μ g + 0.58R 0.001 % + 0.58R 0.0005 % + 0.58R 0.0002 % + 0.58R 0.012 % + 0.58R	Comparison to Class 1 weights Comparison to Class F weights



Parameter/Equipment	Range	CMC ² (±)	Comments
Durometer Calibration : (A, B, C, D, DO, E, M, O, OO, OOO)			ASTM D2240
Indenter Extension and Shape –			
Extension	Up to 0.2 in	340 μin	Optical inspection under magnification
Diameter	Diameter of the base of the frustrum: 0.5 in	340 μin	
	Diameter of the top of the frustrum: 0.5 in	340 μin	
	Diameter of the base of the cone: 0.5 in	340 μin	
Angle			
35° right circular conical frustrum	Cone angle	0.012°	
30° cone	Cone angle	0.012°	
Radius	Tip radius: 0.25 in	340 μin	
Indenter Display	Indenter thickness Indenter radius	240 μin 240 μin	
Spring Calibration – Force	(0 to 100) duro units (0 to 5000) gf	0.089 duro units 0.6 gf	Balance or electronic force cell



Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Rockwell Hardness and Rockwell Superficial Hardness Tester ³	HRA:		Indirect Verification per ASTM E18
	Low	1.2 HRA	
	Medium	1.2 HRA	
	High	0.60 HRA	
	HRBW:		
	Low	1.2 HRBW	
	Medium	1.2 HRBW	
	High	1.2 HRBW	
	HRC:		
	Low	0.91 HRC	
	Medium	0.68 HRC	
	High	0.50 HRC	
	HR15N:		
Low	0.70 HR15N		
Medium	0.70 HR15N		
High	0.81 HR15N		
HR15TW:			
Low	1.2 HR15TW		
Medium	1.2 HR15TW		
High	1.2 HR15TW		
HR30N:			
Low	1.2 HR30N		
Medium	0.98 HR30N		
High	0.82 HR30N		
HR30TW:			
Low	1.2 HR30TW		
Medium	1.2 HR30TW		
High	1.2 HR30TW		
HR45N:			
Low	1.2 HR45N		
Medium	1.2 HR45N		
High	0.82 HR45N		
HR45TW:			
Low	1.2 HR45TW		
Medium	1.2 HR45TW		
High	1.2 HR45TW		



Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Microindentation Hardness Testers (Knoop and Vickers) ³	(100 to 250) HK (250 to 650) HK >650 HK (100 to 900) HV	11 HK 11 HK 27 HK 10 HV	Indirect verification method per ASTM E384
Indirect Verification of Brinell Hardness Testers at Test Conditions ³ – 10/3000/15	(200 to 399) HBW (400 to 600) HBW	4.4 HBW 6.9 HBW	Indirect verification method per ASTM E10

IX. Optical Quantities

Parameter/Equipment	Range	CMC ^{2, 4, 5} (±)	Comments
Gloss Meters ³	Up to 100 GU	0.74 GU + 0.58R	Gloss standards
Light – Measure			
White	(0 to 3000) FC (0 to 42 000) lux	4.1 % 5.5 %	Radiometer standards Radiometer standards
Black @ 365 nm	(0 to 3000) μW/cm ²	6.0 %	Radiometer standards

X. Thermodynamics

Parameter/Equipment	Range	CMC ^{2,4} (\pm)	Comments
Temperature Measuring Equipment ³ – Liquid in Glass Thermometers, Dial, Surface, RTDs, and Thermocouples	-196 °C to 650 °C 650 °C to 1200 °C	0.025 °C + 0.58R 0.5 °C + 0.58R	Master PRT display with probe, temperature bath Block calibrations with master TC
Temperature – Measure ³	-196 °C to 650 °C 650 °C to 1200 °C	0.025 °C 0.5 °C	Master PRT display with probe Type N TC probe with display
Relative Humidity – Measure ³	(10 to 95) % RH	1.4 % RH	Vaisala HMP Series
Relative Humidity – Measuring Equipment	(10 to 95) % RH	0.6 % RH	Thunder Scientific 2500
Ovens, Chambers, Freezers, Furnaces ^{3,9}	(-196 to 400) °C (>400 to 1200) °C	0.14 °C 1.1 °C	Fluke 1523 with RTD Fluke 753 with TC
IR – Measuring Equipment ³	(-30 to 150) °C (50 to 500) °C	0.53 °C 1.0 °C	Hart 9133 Hart 9132

XI. Time & Frequency

Parameter/Equipment	Range	CMC ² (±)	Comments
Frequency – Measure ³	10 Hz to 18 GHz	2 parts in 10 ⁸ Hz/Hz	HP 5334B, HP 5343A GPS receiver
Frequency – Measuring Equipment ³	10 Hz to 18 GHz	2 parts in 10 ⁸ Hz/Hz	HP 3325B, HP 83640B GPS receiver
Tachometer – Optical ³	(0 to 60 000) RPM	0.001 RPM	Agilent 3325B
Stopwatches and Timers ³	(0.1 to 86 400) s	0.03 s/day	Helmut Timometer

¹ This laboratory offers commercial calibration service, field calibration service, and dimensional testing 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 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 length of the unit under test in inches; and R is the resolution of the device under test.

⁵ In the statement of CMC, the first percentage given is the percentage of the reading, unless otherwise noted; the second percentage or fraction given is a percentage or fraction of the range.

⁶ "Supermicrometer" is a registered trade mark registered to Pratt & Whitney Measurement Systems, Inc., Connecticut U.S.A.

⁷ This test is not equivalent to that of a calibration.

⁸ This laboratory meets R205 – *Specific Requirements: Calibration Laboratory Accreditation Program* for the types of dimensional tests listed above and is considered equivalent to that of a calibration.

⁹ The CMC does not include the influence of the unit under test.

¹⁰ 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. CMC's 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.



Accredited Laboratory

A2LA has accredited

APPLIED TECHNICAL SERVICES, INC.

Marietta, GA

for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCSLI Z540-1-1994 and any additional program requirements in the field of calibration. 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 8 January 2009).



Presented this 4th day of April 2016.

A handwritten signature in black ink, appearing to read "L. S. ...", positioned above a horizontal line.

President and CEO
For the Accreditation Council
Certificate Number 1888.03
Valid to April 30, 2018
Revised January 15, 2018

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