



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

TOOL TESTING LAB, INC.
 11601 N Dixie Dr
 Tipp City, OH 45371
 Max Luehmann 937 898 5696
 Sheila Sennet 937 898 5696

CALIBRATION

Valid To: October 31, 2024

Certificate Number: 6176.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations listed below:^{1,4}

I. Acoustical Quantities

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Acoustic ³ – Measure	94 dB @ 1 kHz 114 dB @ 1kHz	0.14 dB	Acoustic calibrator
Acoustic ³ – Measuring Equipment	94 dB @ 1 kHz 114 dB @ 1kHz	0.14 dB	Acoustic calibrator/meter

II. Chemical

Parameter/Equipment	Range	CMC ² (±)	Comments
Conductivity Meter ³	10 µS/cm 100 µS/cm 1000 µS/cm 1400 µS/cm 10 000 µS/cm 100 000 µS/cm	0.037 µS/cm 0.64 µS/cm 5.9 µS/cm 5.9 µS/cm 38 µS/cm 380 µS/cm	Conductivity solutions

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
pH Meter ³	4 pH 7 pH 10 pH	0.02 pH 0.02 pH 0.02 pH	Buffer solutions
Viscosity, Kinematic – Measuring Equipment	(18 to 23) cSt (127.4 to 173.7) cSt (404.6 to 545.0) cSt	0.22 % of rdg 0.29 % of rdg 0.35 % of rdg	C10 viscosity standard C60 viscosity standard C200 viscosity standard
Viscosity, Dynamic – Measuring Equipment	(19.28 to 33.85) Pa•s (43.32 to 64.18) Pa•s (72.93 to 108.1) Pa•s	0.44 % of rdg 0.58 % of rdg 0.75 % of rdg	RT30000 standard RT60000 standard RT100000 standard

III. Dimensional

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Calipers ³	(0.05 to 24) in (24 to 100) in	(520 + 21L) μin (480 + 22L) μin	Grade 2 gage blocks
Cylindrical Gage, Internal Diameter	(0.125 to 19) in	(15 + 9.7L) μin	Grade 2 gage blocks w/ internal diameter comparator
Cylindrical Gage, Outside Diameter	(0.01 to 27) in (0.01 to 1.2) in	(13 + 19L) μin (23 + 3.8L) μin	Grade 2 gage blocks w/ outside diameter comparator Laser mic
Gage Blocks	(0.05 to 4) in (4 to 24) in	(2 + 2L) μin (3 + 2.1L) μin	Grade 1 blocks w/ gage comparator
Height Gage ³	(0.05 to 48) in	900 μin	Grade 2 gage blocks
Indicator, Plunger ³	Up to 4 in	300 μin	Grade 2 gage blocks
Indicator, Test ³	Up to 0.125 in	100 μin	Grade 2 gage blocks

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Length Standards	(0.05 to 27) in	(20 + 19L) μin	Grade 2 gage blocks w/ comparator
Micrometer, Depth ³	(0.05 to 12) in	650 μin	Grade 2 gage blocks
Micrometer, Inside ³	(1.5 to 24) in	1300 μin	Grade 2 gage blocks
Micrometer, Outside ³	(0.05 to 24) in	(29 + 30L) μin	Grade 2 gage blocks
Protractor ³	Up to 90°	0.01°	Grade 2 gage blocks w/ sine bar
Ruler ³	Up to 36 in	(8000 + 22L) μin	Grade 2 gage blocks
Thread Ring Gage, Pitch Diameter 60°	1/2-80 to 16-6	(100 + 20L) μin	Grade 2 gage blocks w/ comparator & spheres
Thread Plug Gage, Pitch Diameter 60°	0-80 to 20-6	(90 + 19L) μin	Grade 2 gage blocks w/ comparator & wires
CMM Axis Length ³	(12 to 96) in	(70 + 7.4L) μin	Step gage
AACMM Radial Length	Up to 72 in	200 μin	Ball bar, ASME B89.4.10360.2-2008
CMM Repeatability ³	1 in	66 μin	Calibration sphere
CMM Bidirectional Length ³	(1 to 12) in	128 μin	Gage blocks
CMM Squareness ³	(12 to 24) in	(40 + 11L) μin	Ball bar
CMM Volumetric ³	(12 to 96) in	(65 + 6.6L) μin	Ball bar

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
V Block – Parallelism	(1 to 8) in	170 μin	CMM
V Block – Perpendicularity	(1 to 8) in	180 μin	CMM
Bore Gage ³	(0.07 to 12) in	(15 + 1.4L) μin	Gage blocks
Surface Plate Flatness ³	(12 to 160) in	(25 + 0.6D) μin	Auto collimator
Surface Plate, Repeat Reading ³	0.002 in	25 μin	Repeat-o-meter
Optical Comparator Axis Linearity ³	304.8 mm maximum (12 in maximum)	(38 + 5.5L) μin	Gage blocks, glass master, glass scale
Optical Comparator Axial Parallelism ³	(101.6 mm of Y axis travel or maximum Y axis travel is less than 101.6 mm) (4 in of Y axis travel or maximum Y axis travel is less than 4 in)	78 μin	Glass master
Optical Comparator Axial Squareness ³	(101.6 mm of Y axis travel or maximum Y axis travel is less than 101.6 mm) (4 in of Y axis travel or maximum Y axis travel is less than 4 in)	55 μin	Glass master
Optical Comparator Chart Angularity ³	(Up to 90)°	0.018°	Glass master

Parameter/Equipment	Range	CMC ^{2, 5, 6} (±)	Comments
Optical Comparator Magnification ³	5X 10X 20X 31.25X 50X 62.5X 100X	160 μin 160 μin 140 μin 150 μin 160 μin 150 μin 160 μin	Ball check gage, 10 in glass magnification scale
	10X 20X 31.25X 50X 62.5X 100X	170 μin 170 μin 200 μin 220 μin 200 μin 220 μin	Ball check gage, 20 in glass magnification scale
Optical/Video Measuring System (O/VMS), Linear X/Y Axis ³	(0.001 to 24) in	(65 + 6.1L) μin	Glass master
OMS Linear Z Axis ³	(1 to 8) in	(65 + 5.2L) μin	Gage blocks
OMS Axial Squareness ³	(101.6 mm of Y axis travel or maximum Y axis travel is less than 101.6 mm) (4 in of Y axis travel or maximum Y axis travel is less than 4 in)	1.4 μm (57 μin)	Gage blocks
OMS Magnification ³	10X to 200X	56 μin	Glass scale
Roughness – Measure	(16 to 2000) μin	1.6 μin	Profilometer
Roughness – Measuring Equipment	(16 to 2000) μin	1.1 % + 1 μin	Std roughness patch
Flatness – Measure ³	(Up to 40) μin	1.2 μin	Optical flat

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Radius Gages ³	(0.01 to 8) in	(75 + 9.2L) μin	Optical comparator
Thickness Gage Ferrous Nonferrous Ultrasonic ³	(20 to 500) μm (800 to 0.06) in (0.8 to 59) mils	1.4 μm 55 μin 0.055 mils	Thickness standards & gauge blocks

IV. Dimensional Inspection⁹

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
2-Dimensional & 3-Dimensional Features of Manufactured Products & Components Size, Location, & Orientation Using CMM	58 in x 40 in x 25 in	(75 + 9.2L) μin	ANSI Y14.5-M
2-Dimensional & Features of Manufactured Products & Components Size, Location, & Orientation Using an Optical Comparator	24 in x 18 in	(200 + 40L) μin	ANSI Y14.5-M
2-Dimensional & Features of Manufactured Products & Components Size Using a LVDT & Gage Blocks	10 μin to 48 in	(30 + 20L) μin	ANSI Y14.5-M
2-Dimensional & Features of Manufactured Products & Components Size Using a DMS	50 μin to 2 in	(20 + 10L) μin	ANSI Y14.5-M
2-Dimensional & Features of Manufactured Products & Components Size Using a Vernier Micrometer	(2 to 10) in	(30 + 20L) μin	ANSI Y14.5-M

V. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
DC Voltage ³ – Measure	60 nV to 1 mV (1 to 10) mV	50 μV/V + 20 nV 50 μV/V + 30 nV	Agilent 34420A
	1 μV to 100 mV 100 mV to 1 V (1 to 10) V (10 to 100) V 100 V to 1 kV	10 μV/V + 0.3 μV 9 μV/V + 0.3 μV 9 μV/V + 0.5 μV 10 μV/V + 350 μV 10 μV/V + 1.3 mV	Agilent 3458A
	(1 to 40) kV	2 μV/V	Divider w/ DMM
DC Voltage ³ – Generate	2 μV to 220 mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V 220 V to 1.1 kV	8 μV/V + 0.6 μV 7 μV/V + 1 μV 7 μV/V + 3.5 μV 7 μV/V + 6.5 μV 8 μV/V + 80 μV 9 μV/V + 500 μV	Fluke 5700A
	(1 to 40) kV	2 % of rdg	DMM w/ divider
Fixed Point	10 V	2 μV/V	Fluke 732A
DC Current ³ – Measure	(1 to 100) μA 100 μA to 1 mA	4 μA/A + 0.6 nA 30 μA/A + 0.6 nA	Agilent 34420A
	(1 to 10) mA (10 to 100) mA 100 mA to 1 A	30 μA/A + 0.1 nA 0.4 μA/A + 0.6 μA 130 μA/A + 12 μA	Agilent 3458A
	(1 to 2) A (2 to 20) A	190 μA/A + 16 μA 400 μA/A + 40 μA	Fluke 8508A
DC Current ³ – Generate	24 nA to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A	50 μA/A + 8 nA 50 μA/A + 80 nA 60 μA/A + 0.8 μA 80 μA/A + 25 μA	Fluke 5700A
	(1.1 to 3.0) A (3.0 to 11) A (11 to 20.5) A	4 mA/A + 120 μA 0.5 mA/A + 6 mA 1 mA/A + 16 mA	Fluke 5520A
	(20 to 1000) A	0.5 % of rdg + 0.5 A	Fluke 5520A w/ coil

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Resistance ³ – Measure	100 μΩ 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	17 μΩ/Ω + 4 μΩ 9.5 μΩ/Ω + 14 μΩ 8 μΩ/Ω + 50 μΩ 8 μΩ/Ω + 0.5 mΩ 8 μΩ/Ω + 5 mΩ 8 μΩ/Ω + 50 mΩ 9 μΩ/Ω + 1 Ω	Fluke 8508A
	(1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1 GΩ	52 Ω/MΩ + 100 Ω 520 Ω/MΩ + 1.5 kΩ 5 kΩ/MΩ + 11 kΩ	Fluke 3458A
Resistance ³ – Generate	(0.1 to 1) Ω (1 to 1.9) Ω (1.9 to 10) Ω (10 to 19) Ω (19 to 100) Ω (100 to 190) Ω 190 Ω to 1 kΩ (1 to 1.9) kΩ (1.9 to 10) kΩ (10 to 19) kΩ (19 to 100) kΩ (100 to 190) kΩ 190 to 1 MΩ (1 to 1.9) MΩ (1.9 to 10) MΩ (10 to 19) MΩ (19 to 100) MΩ	95 μΩ/Ω 95 μΩ/Ω 28 μΩ/Ω 27 μΩ/Ω 17 μΩ/Ω 17 μΩ/Ω 13 μΩ/Ω 13 μΩ/Ω 12 μΩ/Ω 12 μΩ/Ω 14 μΩ/Ω 14 μΩ/Ω 20 μΩ/Ω 21 μΩ/Ω 40 μΩ/Ω 47 μΩ/Ω 110 μΩ/Ω	Fluke 5700A
Resistance ³ – Generate	(1 to 11) Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω 330 Ω to 1.1 kΩ (1.1 to 11) kΩ (11 to 110) kΩ 110 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	2 mΩ 30 μΩ/Ω + 2 mΩ 15 μΩ/Ω + 2 mΩ 0.04 mΩ/Ω + 2 mΩ 0.04 mΩ/Ω + 2 mΩ 35 mΩ/kΩ + 25 mΩ 35 mΩ/kΩ + 250 mΩ 36 mΩ/kΩ + 35 Ω 140 Ω/MΩ + 55 Ω 320 Ω/MΩ + 55 Ω 0.2 kΩ/MΩ + 3 kΩ 0.5 kΩ/MΩ + 3.5 kΩ 3 kΩ/MΩ + 0.1 MΩ 15 kΩ/MΩ + 5 MΩ	Fluke 5520A

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Capacitance ³ – Generate	(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 % of rdg + 0.01 nF 0.25 % of rdg + 0.3 nF 0.25 % of rdg + 3 nF 0.4 % of rdg + 30 nF 0.45 % of rdg + 300 nF 0.45 % of rdg + 3 μF 0.75 % of rdg + 30 μF 1.1 % of rdg + 100 μF	Fluke 5520A
Capacitance ³ – Measure	1 pF to 90 mF	0.024 % of rdg	GR 1689
Inductance ³ – Generate	1.0 H 100 mH 10 mH 1.0 mH 100 μH	0.03 % of rdg	Standard inductors
Inductance ³ – Measure	1 μH to 1000 H	0.02% of rdg	GR 1689

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments
AC Voltage ³ – Generate			
15 μV to 2.2 mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz	550 μV/V + 4.5 μV 210 μV/V + 4.5 μV 100 μV/V + 4.5 μV 370 μV/V + 4.5 μV	Fluke 5700A
21 μV to 2.2 mV	(50 to 100) kHz	850 μV/V + 7 μV	
39 μV to 2.2 mV	(100 to 300) kHz	1100 μV/V + 13 μV	
75 μV to 2.2 mV	(300 to 500) kHz 500 kHz to 1 MHz	1700 μV/V + 25 μV 3400 μV/V + 25 μV	
(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	550 μV/V + 5 μV 210 μV/V + 5 μV 100 μV/V + 5 μV 370 μV/V + 5 μV 850 μV/V + 7 μV 1100 μV/V + 25 μV 1700 μV/V + 35 μV 3400 μV/V + 80 μV	

Parameter/Range	Frequency	CMC ^{2,7} (±)	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	550 μV/V + 13 μV 210 μV/V + 8 μV 110 μV/V + 8 μV 320 μV/V + 8 μV 850 μV/V + 25 μV 1100 μV/V + 25 μV 1700 μV/V + 35 μV 3400 μV/V + 80 μV	Fluke 5700A
220 mV to 2.2 V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	500 μV/V + 80 μV 160 μV/V + 25 μV 75 μV/V + 6 μV 120 μV/V + 16 μV 250 μV/V + 70 μV 430 μV/V + 130 μV 1100 μV/V + 350 μV 2200 μV/V + 850 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	500 μV/V + 800 μV 160 μV/V + 250 μV 750 μV/V + 60 μV 120 μV/V + 160 μV 250 μV/V + 350 μV 500 μV/V + 1.5 mV 1300 μV/V + 4.3 mV 2700 μV/V + 8.5 mV	
(22 to 220) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	500 μV/V + 8 mV 160 μV/V + 2.5 mV 80 μV/V + 0.8 mV 220 μV/V + 3.5 mV 500 μV/V + 8 mV 1500 μV/V + 90 mV 4700 μV/V + 90 mV 11 000 μV/V + 190 mV	
220 V to 1.1 kV	(15 to 50) Hz 50 Hz to 1 kHz	400 μV/V + 16 mV 80 μV/V + 3.5 mV	
AC Voltage ³ – Measure			
1 V 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	0.4 μV /mV + 0.4 μV 0.5 μV /mV + 0.21 μV 0.64 μV /mV + 0.21 μV 1.2 μV /mV + 0.21 μV 2.6 μV /mV + 2.2 μV 76 μV /mV + 4 μV	Agilent 3458A

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments
AC Voltage ³ – Measure (cont)			
(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	0.03 % of rdg + 4 µV 0.02 % of rdg + 2 µV 0.03 % of rdg + 2 µV 0.1 % of rdg + 2 µV 0.5 % of rdg + 2 µV 4 % of rdg + 3 µV	Agilent 3458A
10 mV 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	70 µV/V + 450 µV 70 µV/V + 250 µV 140 µV/V + 250 µV 300 µV/V + 250 µV 800 µV/V + 250 µV 300 µV/V + 1 mV 1000 µV/V + 1 mV 15 000 µV/V + 1 mV	
(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	200 µV/V + 4 mV 200 µV/V + 2 mV 200 µV/V + 2 mV 350 µV/V + 2 mV 1200 µV/V + 2 mV 4000 µV/V + 10 mV 15 000 µV/V + 10 mV	
(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	400 µV/V + 40 mV 400 µV/V + 20 mV 600 µV/V + 20 mV 1200 µV/V + 20 mV 3000 µV/V + 20 mV	
AC Current ³ – Generate			
550 nA to 220 µA	(10 to 20) Hz (1 to 5) kHz	180 nA 170 nA	Fluke 5700A
300 nA to 220 µA	(20 to 40) Hz	97 nA	
150 nA to 220 µA	40 Hz to 1 kHz	47 nA	
(1.3 to 220) µA	(5 to 10) kHz	430 nA	
220 µA 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	1.6 µA 800 nA 350 nA 1.7 µA 4.4 µA	
(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	16 µA 8.1 µA 3.5 µA 18 µA 43 µA	

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments
AC Current ³ – Generate (cont) (22 to 220) mA 220 mA to 2.2 A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	160 µA 81 µA 35 µA 180 µA 430 µA 1.5 mA 1.8 mA 19 mA	Fluke 5700A
AC Current ³ – Generate (2.2 to 3) A (3 to 11) A (11 to 20.5) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	180 µA/A + 0.2 mA 60 µA/A + 0.1 mA 600 µA/A + 1 mA 25 000 µA/A + 5 mA 100 µA/A + 2 mA 1000 µA/A + 5 mA 30 000 µA/A + 2 mA 120 µA/A + 5 mA 150 µA/A + 5 mA 30 000 µA/A + 5 mA	Fluke 5520A
AC Current ³ – Generate; Clamp-On Meter (20.5 to 1025) A	(45 to 65) Hz (65 to 440) Hz	1 % of rdg 1.2 % of rdg	Fluke 5520A w/ coil

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Oscilloscopes ³ – Level Sine Wave Flatness, Relative to 10 MHz 50 kHz to 100 MHz (100 to 300) MHz (0.3 to 3.2) GHz Square Wave DC Signal, 50 Ω DC Signal, 1 MΩ Time Marker 50 Ω	 5 mV to 5.5 V 5 mV to 5.5 V 5 mV to 5.5 V (-6.6 to 6.6) V (-130 to 130) V 5 s to 50 ms 20 ms to 1 ns	 1.5 % of rdg + 100 µV 2 % of rdg + 100 µV 7 % of rdg + 100 µV 0.25 % of rdg + 40 µV 0.05 % of rdg + 40 µV (20 + 1000t) µs/s 2.5 µs/s	 Fluke 5520A/SC300 Fluke 9500B/9530 Fluke 5520A/SC300 t = time in µs

Parameter/Range	Frequency	CMC ^{2,7} (\pm)	Comments
AC Current ³ – Measure			
(5 to 100) μ A	(10 to 20) Hz (20 to 45) Hz 45 Hz to 5 kHz	4000 μ A/A + 30 nA 1500 μ A/A + 30 nA 600 μ A/A + 30 nA	Agilent 3458A
(0.1 to 1) 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	4000 μ A/A + 200 nA 1500 μ A/A + 200 nA 600 μ A/A + 200 nA 300 μ A/A + 200 nA 600 μ A/A + 200 nA 4000 μ A/A + 400 nA 5500 μ A/A + 1.5 μ A	
(1 to 10) 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	4000 μ A/A + 2 μ A 1500 μ A/A + 2 μ A 600 μ A/A + 2 μ A 300 μ A/A + 2 μ A 600 μ A/A + 2 μ A 4000 μ A/A + 4 μ A 5500 μ A/A + 15 μ A	
(10 to 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	4000 μ A/A + 20 μ A 1500 μ A/A + 20 μ A 600 μ A/A + 20 μ A 300 μ A/A + 20 μ A 600 μ A/A + 20 μ A 4000 μ A/A + 40 μ A 5500 μ A/A + 150 μ A	
100 mA to 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	4000 μ A/A + 200 μ A 1600 μ A/A + 200 μ A 800 μ A/A + 200 μ A 1000 μ A/A + 200 μ A 3000 μ A/A + 200 μ A 10 000 μ A/A + 400 μ A	
200 mA to 2 A	10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz	620 μ A/A + 200 μ A 740 μ A/A + 200 μ A 30 000 μ A/A + 200 μ A	
(2 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	820 μ A/A + 200 μ A 25 000 μ A/A + 200 μ A	
(5 to 100) μ A	(10 to 20) Hz (20 to 45) Hz 45 Hz to 5 kHz	0.0043 μ A/A + 0.03 mA 0.002 μ A/A + 0.03 mA 0.0007 μ A/A + 0.03 mA	

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments
AC Current ³ – Measure (cont)			
(0.1 to 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	4 μA/mA + 23 μA 2 μA/mA + 23 μA 1 μA/mA + 23 μA 0.4 μA/mA + 23 μA 1 μA/mA + 23 μA 4 μA/mA + 45 μA 6 mA/mA + 160 μA	Agilent 3458A
100 mA to 1 A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5kHz (5 to 20) kHz (20 to 50) kHz	2 mA/A + 0.2 mA 1 mA/A + 0.2 mA 1.3 mA/A + 0.2 mA 1.2 mA/A + 0.2 mA 3 mA/A + 0.2 mA 11 mA/A + 0.4 mA	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation of Thermocouple & Thermocouple Indicating Systems ³ –			
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1800) °C	0.44 °C 0.34 °C 0.3 °C 0.33 °C	Fluke 5520A
Type C	(0 to 150) °C (1000 to 1800) °C (1800 to 2316) °C (150 to 650) °C (650 to 1000) °C	0.3 °C 0.5 °C 0.84 °C 0.26 °C 0.31 °C	
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.5 °C 0.16 °C 0.14 °C 0.16 °C 0.21 °C	
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.27 °C 0.16 °C 0.14 °C 0.17 °C 0.23 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation of Thermocouple & Thermocouple Indicating Systems ³ – (cont)			
Type K	(-210 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.33 °C 0.18 °C 0.16 °C 0.26 °C 0.4 °C	Fluke 5520A
Type L	(-200 to -100) °C (-100 to 800) °C (800 to 900) °C	0.37 °C 0.26 °C 0.17 °C	
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.4 °C 0.22 °C 0.19 °C 0.18 °C 0.27 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.57 °C 0.35 °C 0.33 °C 0.4 °C	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.47 °C 0.36 °C 0.37 °C 0.46 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.63 °C 0.24 °C 0.16 °C 0.14 °C	
Type U	(-200 to 0) °C (0 to 600) °C	0.56 °C 0.27 °C	
Electrical Calibration of RTD Indicating Systems ³ –			
Pt 385, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.05 °C 0.07 °C 0.09 °C 0.1 °C 0.12 °C 0.23 °C	Fluke 5520A

VI. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments
RF Power ³ – Measure (1 x 10 ⁻¹⁶ to 2.5 x 10 ⁻¹) W (24 to -130) dBm (1 x 10 ⁻¹⁶ to 2.5 x 10 ⁻²) W (14 to -130) dBm	(10 to 12.5) MHz 12.5 MHz to 4 GHz	0.05 dB 0.06 dB	HP 8568B W = reference power from source in watts
RF Power ³ – Generate (1 x 10 ⁻¹⁶ to 2.5 x 10 ⁻¹) W (24 to -130) dBm (1 x 10 ⁻¹⁶ to 2.5 x 10 ⁻²) W (14 to -130) dBm	(10 to 12.5) MHz 12.5 MHz to 4 GHz	0.05 dB 0.06 dB	HP 8340B W = reference power from source in watts

VII. Fluid Quantities

Parameter/Equipment	Range	CMC ² (±)	Comments
Micropipettes ³	(1 to 10) µL (10 to 100) µL (100 to 1000) µL	0.19 nL 0.19 µL 1.9 µL	SG204, SOP14
Beakers ³	25 mL 50 mL 100 mL 150 mL 250 mL 400 mL 600 mL 800 mL 1 L 2 L	0.29 mL 0.58 mL 1.2 mL 1.7 mL 2.9 mL 4.6 mL 6.9 mL 9.2 mL 12 mL 23 mL	BG204, SOP14 EX1103, SOP14 EX1103, SOP14, gravimetric method SG32001, SOP14

Parameter/Equipment	Range	CMC ² (±)	Comments
Burettes ³	10 mL 25 mL 50 mL 100 mL	27 µL 60 µL 0.13 mL 0.14 mL	SG204, SOP14, gravimetric method
Flasks ³	1 mL 2 mL 5 mL 10 mL 20 mL 25 mL 50 mL 100 mL 200 mL 250 mL 500 mL 1 L 2 L	4.8 µL 6.4 µL 14 µL 27 µL 49 µL 60 µL 0.13 mL 0.13 mL 0.27 mL 0.27 mL 0.59 mL 1.4 mL 3.4 mL	SG204, SOP14, gravimetric method EX1103, SOP14, gravimetric method SG32001, SOP14, gravimetric method
Graduated Cylinders ³	1 mL 2 mL 5 mL 10 mL 20 mL 25 mL 50 mL 100 mL 250 mL 500 mL 1 L 2 L	4.8 µL 6.4 µL 14 µL 27 µL 49 µL 60 µL 0.13 mL 0.13 mL 0.27 mL 0.59 mL 1.4 mL 3.4 mL	SG204, SOP14, gravimetric method EX1103, SOP14, gravimetric method SG32001, SOP14, gravimetric method

Parameter/Equipment	Range	CMC ² (±)	Comments
Test Tubes ³	3 mL	6.4 µL	SG204, gravimetric method
	5 mL	14 µL	
	10 mL	27 µL	
	20 mL	53 µL	
	25 mL	58 µL	
	50 mL	140 µL	
	100 mL	140 µL	
	500 mL	590 µL	EX1103, gravimetric method
	1 L	1.2 mL	
	2 L	3.4 mL	SG32001, gravimetric method
Flow Meter ³ – N ₂ /Air	(0.5 to 100) mL/min	0.8 % of rdg + 0.3 mL/min	Alicat M-series
	(1 to 700) mL/min	1 % of rdg + 0.15 mL/min	DC-1LC
	(0.1 to 30) L/min	0.2 % of rdg + 0.01 L/min	Molbox/molbloc
	(30 to 50) L/min	0.2 % of rdg + 0.02 L/min	
	(50 to 3200) L/min	0.3 % of rdg + 0.3 L/min	N ₂ flow bench
Flow Meter ³ – H ₂ O	(1 to 60) L/min	0.7 % of rdg + 0.02 L/min	H ₂ O flow bench
Flow Meter ³ – Hydraulic Flow	(1.9 to 230) L/min	0.3 % of rdg + 0.03 L/min	Hydraulic flow bench

VIII. Ionizing Radiation & Radioactivity

Parameter/Equipment	Range	CMC ² (±)	Comments
Nuclear Density Gauge ¹⁰	Density	(1770 to 2434) kg/m ³	Density & moisture blocks
	Moisture	(0 to 570) kg/m ³	
Nuclear Density Gauge – Contamination Leak Test ¹⁰	(9.5 x 10 ⁻⁴ to 1.8 x 10 ⁻³) µCi (35 - 650) Bq	(3.3 x 10 ⁻⁵) µCi	Alpha beta counter w/ scintillator probe

Parameter/Equipment	Range	CMC ^{2, 5, 6} (±)	Comments
Pressure ³ – Measure	Up to 100 psig	0.01 % of rdg + 0.003 psi	CPC4000
Pressure ³ – Measure	Up to 1000 psig	0.01 % of rdg + 0.03 psi	CPC4000
Pressure ³ – Measure	Up to 13.2 psia Up to 40 psia (40 to 165) psia (165 to 500) psia	0.002 psi 0.008 % of rdg 0.02 psi 0.008 % of rdg	CPT9000 transducers
Pressure Transducer ³	(58 to 16 000) psig	0.0075 % rdg	DHI piston gauge
Torque Transducer ³	(0.16 to 4000) ozf•in (2.5 to 2500) lbf•ft (0.01 to 2500) lbf•ft	0.05 % rdg 0.05 % rdg 0.1 % rdg	Wheel w/ weights, bar w/ weights, torque calibrator
Torque Wrench ³	(160 to 1600) ozf•in (1 to 100) lbf•ft (100 to 500) lbf•ft (500 to 2500) lbf•ft	1 % rdg + 4 ozf•in 0.38 % rdg + 0.05 lbf•ft 0.5 % rdg + 2.4 lbf•ft 1 % rdg + 2.8 lbf•ft	1600 calibrator 100 calibrator 500 calibrator 2500 calibrator
Durometer – Indentor Spring Force ³ Only Type A, B, C, D, DO, E, M, O, OO, OOO, OOO-S	Up to 4.53 kg	1.3 g	ASTM D2240

Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Rockwell Hardness & Rockwell Superficial Hardness Testers ³ –	HRBW:		Rockwell hardness test block
	(40 to 59) HRBW	0.7 HRBW	
	(59 to 79) HRBW	0.71 HRBW	
	(79 to 100) HRBW	0.6 HRBW	
	HRC:		
	(20 to 35) HRC	0.45 HRC	
	(35 to 55) HRC	0.44 HRC	
	(55 to 65) HRC	0.38 HRC	
	HRA:		
	(20 to 65) HRA	0.46 HRA	
	(65 to 78) HRA	0.23 HRA	
	(78 to 84) HRA	0.24 HRA	
	HR15N:		
	(70 to 77) HR15N	0.4 HR15N	
	(77 to 88) HR15N	0.33 HR15N	
	(88 to 92) HR15N	0.27 HR15N	
	HR30N:		
	(40 to 54) HR30N	0.45 HR30N	
	(54 to 76) HR30N	0.39 HR30N	
	(76 to 86) HR30N	0.35 HR30N	
	HR45N:		
	(19 to 36) HR45N	0.53 HR45N	
	(36 to 65) HR45N	0.45 HR45N	
	(65 to 78) HR45N	0.45 HR45N	
HR15TW:			
(60 to 80) HR15TW	0.6 HR15TW		
(80 to 86) HR15TW	0.45 HR15TW		
(86 to 93) HR15TW	0.37 HR15TW		
HR30TW:			
(15 to 56) HR30TW	0.56 HR30TW		
(56 to 69) HR30TW	0.45 HR30TW		
(69 to 83) HR30TW	0.38 HR30TW		
HR45TW:			
(1 to 32) HR45TW	0.55 HR45TW		
(32 to 52) HR45TW	0.5 HR45TW		
(52 to 73) HR45TW	0.47 HR45TW		

X. Optical Quantities

Parameter/Equipment	Range	CMC ² (±)	Comments
Illuminance Response – Measuring Equipment ³	(100 to 4500) fc	0.58 % of rdg + 0.45 fc	Standard of illuminance
Spectral Irradiance – Measure ³	100 μW/cm ² to 5 mW/cm ² @ 365 nm	0.98 % of rdg + 5.0 μW/cm ²	Radiometer & detector
Wavelength – Measure ³	(253 to 579) nm	0.01 nm	Spectral lamps
	(200 to 1100) nm	0.05 nm	Spectral radiometer

XI. Thermodynamics

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Humidity – Measuring Equipment ³	33 % RH 75 % RH	1.0 % RH 1.1 % RH	Vaisala w/ salts chamber
	(25 to 75) % RH	0.57 % RH	Thunder 2500
Relative Humidity – Measure ³	(10 to 90) % RH	1.1 % RH	Vaisala HMI41/HMP46
IR Temperature Devices ³	(35 to 500) °C	0.34 % of rdg + 0.38 °C	IR calibrator
Temperature ³ – Measure	(-90 to 660) °C	0.12 °C	SPRT w/display
Temperature ³ – Measuring Equipment	(-20 to 150) °C (-90 to 140) °C (50 to 700) °C (0 to 70) °C	0.02 °C 0.08 °C 0.09 °C 0.16 °C	SPRT w/ bath SPRT w/ 9190 SPRT w/ 9173 Thunder 2500

XII. Time & Frequency

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Frequency ³ – Generate	10 Hz to 22.6 GHz	(6.8 x 10 ⁻⁹) Hz / Hz	Generator w/ GPSDO
Fixed Point	10 MHz	2 µHz	GPSDO
Frequency ³ – Measure	10 Hz to 3 GHz	(4.7 x 10 ⁻⁹) Hz / Hz	Counter w/ GPSDO
Fixed Point	10 MHz	2 µHz	GPSDO
Time Intervals, Timers ³	(6 x 10 ⁻⁹ to 1 x 10 ⁶) s	0.038 s/day	Counter
Stopwatches ³	Up to 24 hrs	0.68 s	Direct comparison, stopwatch, or universal counter
		6 ms	Time base method universal counter
		0.036 s/day	Timometer

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

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. CMC's 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 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 This scope meets A2LA's *P112 Flexible Scope Policy*.

⁵ 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.

⁶ In the statement of CMC, L is the nominal length of device measure in inches or meters appropriate to the uncertainty statement, D is the diameter of the device in inches or meters appropriate to the uncertainty statement, and Wt represents weight in pounds or grams (including SI multiple and submultiple units) appropriate to the uncertainty statement.

⁷ The stated measured values are determined using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure or generate the measured value in the ranges indicated. CMCs are expressed as either a specific value that covers the full range or as a percent or fraction of the reading plus a fixed floor specification.

⁸ This laboratory also uses customer supplied specifications and/or methods developed by the lab and approved by the client directly related to the types of tests and within the parameters listed above.

⁹ 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.

¹⁰ Nuclear Density Gauge calibrations are performed at the following address: 3800 Lightner Rd. Vandalia, OH, 45377.



Accredited Laboratory

A2LA has accredited

TOOL TESTING LAB, INC.

Tipp City, OH

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 R205 – Specific Requirements: Calibration Laboratory Accreditation Program. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



Presented this 29th day of December 2022.

A blue ink signature of Mr. Trace McInturff, written in a cursive style.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 6176.01
Valid to October 31, 2024

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