



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

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CALIBRATION

Valid To: December 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 – Measure | | | |
| (5 to 100) μA | (10 to 20) Hz (20 to 45) Hz 45 Hz to 5 kHz | 4000 μA/A + 30 nA 1500 μA/A + 30 nA 600 μA/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 μA/A + 200 nA 1500 μA/A + 200 nA 600 μA/A + 200 nA 300 μA/A + 200 nA 600 μA/A + 200 nA 4000 μA/A + 400 nA 5500 μA/A + 1.5 μA | |
| (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 μA/A + 2 μA 1500 μA/A + 2 μA 600 μA/A + 2 μA 300 μA/A + 2 μA 600 μA/A + 2 μA 4000 μA/A + 4 μA 5500 μA/A + 15 μA | |
| (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 μA/A + 20 μA 1500 μA/A + 20 μA 600 μA/A + 20 μA 300 μA/A + 20 μA 600 μA/A + 20 μA 4000 μA/A + 40 μA 5500 μA/A + 150 μA | |
| 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 μA/A + 200 μA 1600 μA/A + 200 μA 800 μA/A + 200 μA 1000 μA/A + 200 μA 3000 μA/A + 200 μA 10 000 μA/A + 400 μA | |
| 200 mA to 2 A | 10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz | 620 μA/A + 200 μA 740 μA/A + 200 μA 30 000 μA/A + 200 μA | |
| (2 to 20) A | 10 Hz to 2 kHz (2 to 10) kHz | 820 μA/A + 200 μA 25 000 μA/A + 200 μA | |
| (5 to 100) μA | (10 to 20) Hz (20 to 45) Hz 45 Hz to 5 kHz | 0.0043 μA/A + 0.03 mA 0.002 μA/A + 0.03 mA 0.0007 μA/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 over a horizontal line.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 6176.01
Valid to December 31, 2024
Revised November 20, 2024

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