



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017
& ANSI/NCSL Z540-1-1994 & ANSI/NCSL Z540-3-2006

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CALIBRATION

Valid To: February 29, 2020

Certificate Number: 2398.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations¹:

IV. Chemical

| Parameter/Equipment | Range | CMC ^{2,5} (±) | Comments |
|---------------------|--|---------------------------------|------------------------|
| pH Meters | (4 to 10) pH | 0.003 pH | Buffer solutions |
| Conductivity Meters | 1 µS 10 µS 100 µS 1000 µS 16.67 mS | 1 % 1 % 1 % 1 % 1 % | Conductivity solutions |

I. Dimensional

| Parameter/Equipment | Range | CMC ² (±) | Comments |
|------------------------------|-------------|----------------------|---|
| Calipers ³ | Up to 60 in | 360 µin | Caliper master/gage blocks/length standards |
| Dial Indicators ³ | Up to 1 in | 300 µin | Gage blocks |
| Test Indicators ³ | Up to 1 in | 32 µin | Gage blocks |

| Parameter/Equipment | Range | CMC ² (±) | Comments |
|---|---------------------------|----------------------|----------------------------------|
| Height Gages ³ | Up to 40 in | 75 µin | Gage blocks and length standards |
| Micrometers ³ | Up to 12 in | 40 µin | Gage blocks and length standards |
| Rulers & Tape Measures | Up to 60 in | 360 µin | Gage blocks |
| Optical Comparators – X & Y Magnification | Up to 12 in Up to 100x | 20 µin 1 µin | Gage blocks |
| Microscopes – X & Y | Up to 4 in | 40 µin | Stage micrometer |

II. Electrical – DC/Low Frequency

| Parameter/Range | Frequency | CMC ^{2,4} (±) | Comments |
|--|---|--|---------------|
| AC Voltage – Measure (1 to 10) mV | (1 to 40) Hz (0.04 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz | 0.03 % + 4 µV 0.02 % + 1.5 µV 0.03 % + 1.5 µV 0.03 % + 1.5 µV 0.5 % + 1.5 µV 4 % + 2.5 µV | Agilent 3458A |
| 100 mV to 1 V | (1 to 40) Hz (0.04 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (1 to 2) MHz | 0.007 % + 0.5 mV 0.007 % + 0.3 mV 0.014 % + 0.3 mV 0.03 % + 0.3 mV 0.08 % + 0.3 mV 0.3 % + 1.1 mV 1.5 % + 1.1 mV | |

| Parameter/Range | Frequency | CMC ^{2,4} (±) | Comments |
|--------------------------------|---|--|---------------|
| AC Voltage – Measure (cont) | | | |
| (10 to 100) V | (1 to 40) Hz (0.04 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz | 0.03 % + 5 mV 0.02 % + 3 mV 0.02 % + 3 mV 0.035 % + 3 mV 0.12 % + 3 mV 0.4 % + 10 mV | Agilent 3458A |
| (100 to 1000) V | (1 to 40) Hz (0.04 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz | 0.04 % + 4 mV 0.04 % + 4 mV 0.06 % + 2 mV 0.12 % + 2 mV 0.3 % + 3 mV | |
| AC Voltage – Generate | | | |
| (1 to 33) mV | (10 to 45) Hz (0.045 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz | 0.08 % + 6 μV 0.15 % + 6 μV 0.02 % + 6 μV 0.1 % + 6 μV 0.35 % + 12 μV 0.8 % + 50 μV | Fluke 5522A |
| (33 to 330) mV | (10 to 45) Hz (0.045 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz | 0.03 % + 8 μV 0.013 % + 8 μV 0.015 % + 8 μV 0.035 % + 8 μV 0.08 % + 32 μV 0.2 % + 70 μV | |
| (0.33 to 3.3) V | (10 to 45) Hz (0.045 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz | 0.03 % + 50 μV 0.012 % + 25 μV 0.019 % + 50 μV 0.03 % + 50 μV 0.07 % + 130 μV 0.24 % + 600 μV | |
| (3.3 to 33) V | (10 to 45) Hz (0.045 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz | 0.03 % + 650 μV 0.015 % + 200 μV 0.024 % + 600 μV 0.035 % + 600 μV 0.09 % + 1.6 mV | |

| Parameter/Range | Frequency | CMC ^{2,4} (±) | Comments |
|---------------------------------|--|---|---------------|
| AC Voltage – Generate (cont) | | | |
| (33 to 330) V | (10 to 45) Hz (0.045 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz | 0.019 % + 2 mV 0.02 % + 6 mV 0.025 % + 6 mV 0.03 % + 6 mV 0.2 % + 50 mV | Fluke 5522A |
| (330 to 1020) V | (45 to 1000) Hz (1 to 5) kHz (5 to 10) kHz | 0.03 % + 10 mV 0.025 % + 10 mV 0.03 % + 10 mV | |
| AC Current – Measure | | | |
| (0.01 to 100) µA | (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz | 0.4 % + 0.03 µA 0.15 % + 0.03 µA 0.06 % + 0.03 µA 0.06 % + 0.03 µA | Agilent 3458A |
| (1 to 100) mA | (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz (5 to 20) kHz (50 to 100) kHz | 0.4 % + 0.02 µA 0.15 % + 0.02 µA 0.06 % + 0.02 µA 0.03 % + 0.02 µA 0.06 % + 0.02 µA 0.55 % + 0.15 µA | |
| (0.1 to 1) A | (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz (5 to 20) kHz (50 to 100) kHz | 0.4 % + 0.2 mA 0.16 % + 0.2 mA 0.08 % + 0.2 mA 0.1 % + 0.2 mA 0.3 % + 0.2 mA 1 % + 0.4 mA | |
| AC Current – Generate | | | |
| (3.3 to 33) mA | (10 to 20) Hz (20 to 45) Hz (0.045 to 1) kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz | 0.18 % + 2 µA 0.09 % + 2 µA 0.04 % + 2 µA 0.08 % + 2 µA 0.2 % + 100 µA 0.4 % + 4 µA | Fluke 5522A |

| Parameter/Range | Frequency | CMC ^{2, 4, 5} (±) | Comments |
|------------------------------------|---|---|--------------------|
| AC Current – Generate (cont) | | | |
| (33 to 330) mA | (10 to 20) Hz (20 to 45) Hz (0.045 to 1) kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz | 0.18 % + 20 µA 0.09 % + 20 µA 0.04 % + 20 µA 0.1 % + 50 µA 0.2 % + 100 µA 0.4 % + 200 µA | Fluke 5522A |
| (0.33 to 1.1) A | (10 to 45) Hz (0.045 to 1) kHz (1 to 5) kHz (5 to 10) kHz | 0.18 % + 100 µA 0.05 % + 100 µA 0.6 % + 1.0 mA 2.5 % + 5.0 mA | |
| (1.1 to 3) A | (10 to 45) Hz (0.045 to 1) kHz (1 to 5) kHz (5 to 10) kHz | 0.18 % + 100 µA 0.05 % + 100 µA 0.6 % + 1.0 mA 2.5 % + 5.0 mA | |
| (3 to 11) A | (45 to 100) Hz (0.1 to 1) kHz (1 to 5) kHz | 0.6 % + 2.0 mA 0.1 % + 2.0 mA 3 % + 2.0 mA | |
| (11 to 20.5) A | (45 to 100) Hz (0.1 to 1) kHz (1 to 5) kHz | 0.12 % + 5.0 mA 0.15 % + 5.0 mA 3 % + 5.0 mA | |
| 20 A to 1 000 A | (45 to 400) Hz | 0.12 % | Fluke 50 turn coil |
| AC Power – Generate PF=1, 60 Hz | 10 mW to 336 W 336 W to 3.06 kW 3.06 kW to 20.9 kW | 0.14 % 0.14 % 0.12 % | Fluke 5522A |

| Parameter/Equipment | Range | CMC ^{2, 4} (±) | Comments |
|----------------------|--|---|---------------|
| DC Voltage – Measure | (0.01 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1000) V | 1.1 µV/V + 3 µV 10 µV/V + 0.3 µV 10 µV/V + 0.05 µV 12 µV/V + 30 µV 12 µV/V + 100 µV | Agilent 3458A |



| Parameter/Equipment | Range | CMC ^{2, 4, 5} (\pm) | Comments |
|------------------------------------|--|---|--|
| DC Voltage – Generate | 0.1 μ V to 330 mV (0.33 to 3.3) V (3.3 to 33) V (33 to 330) V (330 to 1000) V | 23 μ V/V + 2 μ V 13 μ V/V + 4 μ V 14 μ V/V + 35 μ V 21 μ V/V + 250 μ V 21 μ V/V + 1800 μ V | Fluke 5522A |
| DC Current – Measure | 100 nA 1 μ A 10 μ A 100 μ A 1 mA 10 mA 100 mA 1 A | 0.35 nA/A + 0.04 nA 0.25 μ A/A + 0.4 μ A 2.5 μ A/A + 0.05 μ A 2.5 μ A/A + 0.5 μ A 2.5 μ A/A + 0.5 μ A 2.5 μ A/A + 0.1 μ A 4 μ A/A + 0.5 μ A 10 μ A/A + 1 μ A | Agilent 3458A |
| DC Power – Generate | 10 mW to 336 W (336 to 3060) 3060 W to 20.9 kW | 0.05 % 0.05 % 0.1 % | Fluke 5522A |
| AC/DC High Voltage | (1 to 6) kV (1 to 40) kV | 1 % 0.4 kV | Fluke-80-k6 Fluke-80-k40 |
| AC/DC Current – High Pot Tester | (0.01 to 100) mA | 1 % | Fluke-5320A & 5322A decade resistor |
| Resistance – Measure | (0.01 to 11) Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω 330 Ω to 1.1 k Ω (1.1 to 3.3) k Ω (3.3 to 11) k Ω (11 to 33) k Ω (33 to 110) k Ω (110 to 330) k Ω 330 k Ω to 1.1 M Ω (1.1 to 3.3) M Ω (3.3 to 11) M Ω (11 to 33) M Ω | 0.004 % + 0.011 Ω 0.003 % + 0.017 Ω 0.0028 % + 0.017 Ω 0.0028 % + 0.022 Ω 0.0028 % + 0.022 Ω 0.0028 % + 0.22 Ω 0.0028 % + 0.12 Ω 0.0028 % + 1.2 Ω 0.0028 % + 1.2 Ω 0.0032 % + 12 Ω 0.0032 % + 12 Ω 0.006 % + 180 Ω 0.013 % + 300 Ω 0.025 % + 5 k Ω | Agilent 3458A |

| Parameter/Equipment | Range | CMC ^{2,4,5} (\pm) | Comments |
|--------------------------------|--|--|-------------------|
| Resistance – Measure (cont) | (33 to 110) M Ω (110 to 330) M Ω (330 to 1100) M Ω | 0.05 % + 6 k Ω 0.3 % + 0.2 M Ω 1.5 % + 1 M Ω | Agilent 3458A |
| Fixed Points | 0.01 Ω 0.1 Ω 1 Ω 10 Ω 100 Ω 1 k Ω 10 k Ω 100 k Ω 1 M Ω 10 M Ω | 5 $\mu\Omega$ 30 $\mu\Omega$ 50 $\mu\Omega$ 500 $\mu\Omega$ 5 m Ω 50 m Ω 0.5 Ω 5 Ω 50 Ω 1 k Ω | ESI-SR1-series |
| Insulation Testers | 1 k Ω to 10 T Ω | 1 % | Fluke-5322/VLC/40 |
| Capacitance – Generate | (220 to 400) pF (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) μ F (1.1 to 3.3) μ F (3.3 to 11) μ F (11 to 33) μ F (33 to 110) μ F (110 to 330) μ F (0.33 to 1.1) mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF | 0.5 % + 0.2 nF 0.5 % + 0.1 nF 0.5 % + 0.1 nF 0.25 % + 0.2 nF 0.25 % + 0.2 nF 0.25 % + 0.2 nF 0.25 % + 0.2 nF 0.25 % + 0.2 nF 0.25 % + 4 nF 0.25 % + 0.1 nF 0.45 % + 35 nF 0.45 % + 110 nF 0.45 % + 310 nF 0.45 % + 1020 nF 0.45 % + 3020 nF 0.45 % + 11 μ F 0.75 % + 50 μ F 1.1 % + 120 μ F | Fluke 5522A |
| Fixed Points | 0.01 μ F 0.1 μ F 1 μ F | 0.01 % 0.01 % 0.01 % | Std. capacitors |

| Parameter/Equipment | Range | CMC ^{2,5} (±) | Comments |
|--|--------------------|------------------------|---------------------------|
| Inductance – Generate | 100 mH | 0.01 % | Std. inductor |
| Electrical Simulation of Thermocouples ³ – Generate/Measure | | | |
| Type B | (600.0 to 1820) °C | 0.44 °C | Fluke 5522A, Fluke 744 |
| Type C | (0.0 to 2316) °C | 0.84 °C | |
| Type E | (-250 to 1000) °C | 0.50 °C | |
| Type J | (-210 to 1200) °C | 0.27 °C | |
| Type K | (-200 to 1372) °C | 0.40 °C | |
| Type N | (-200 to 1300) °C | 0.40 °C | |
| Type R | (0.0 to 1767) °C | 0.57 °C | |
| Type S | (0.0 to 1767) °C | 0.47 °C | |
| Type T | (-250 to 400) °C | 0.63 °C | |
| Electrical Simulation of RTDs ³ – | | | |
| Pt 395, 100 Ω | (-200 to 800) °C | 0.05 °C | Fluke 5522A |
| Pt 3926, 100 Ω | (-200 to 630) °C | 0.05 °C | |
| Pt 3916, 100 Ω | (-200 to 630) °C | 0.25 °C | |
| Pt 385, 200 Ω | (-200 to 630) °C | 0.16 °C | |
| Pt 385, 500 Ω | (-200 to 630) °C | 0.11 °C | |
| Pt 385, 1000 Ω | (-200 to 630) °C | 0.23 °C | |
| Pt Ni 385, 120 Ω | (-80 to 260) °C | 0.14 °C | |
| Cu 427, 10 Ω | (-100 to 260) °C | 0.3 °C | |



III. Mechanical

| Parameter/Equipment | Range | CMC ^{2,5} (±) | Comments |
|--------------------------------|--|---|---|
| Pressure ³ | (-15 to 15) psi (0 to 100) psi (0 to 3000) psi (0 to 10 000) psi | 0.04 psi 0.01 psi 1.5 psi 5.3 psi | Pressure modules/gauges Fluke # 700G06 Ashcroft # 2074 & 2089 Fluke # 700P31 |
| Mass – | (1 to 100) mg (100 to 500) mg (1 to 100) g (100 to 500) g 1 kg 2 kg 5 kg 10 kg 20 kg 25 kg 50 lb | 0.008 mg 0.014 mg 0.28 mg 1.4 mg 2.9 mg 5.8 mg 15 mg 29 mg 58 mg 73 mg 0.003 lb | ASTM (Class 2 to Class 7) NIST Class F, OIML (F1, F2, M1, M2, M3) Comparators Standard weights ASTM – Class 1 |
| Balances & Scales ³ | Up to 100 g 1000 g 10 kg 100 lb 1000 lb 2000 lb 3000 lb | 0.15 mg 1.5 mg 15 mg 0.086 lb 0.10 lb 0.50 lb 3.00 lb | Standard weights ASTM – Class 1 Class F |
| Torque Wrenches | (10 to 100) ozf·in (5 to 50) lbf·in (50 to 500) lbf·in (250 to 750) lbf·ft (750 to 2000) lbf·ft | 0.25 % 0.25 % 0.25 % 0.25 % 0.25 % | AWS torque transducers |
| Torque Transducers | Up to 250 lbf·ft | 0.025 % | Standard weights & torque wheels |
| Force | Up to 10 lb Up to 100 lb Up to 1000 lb Up to 10 000 lb Up to 100 000 lb Up to 200 000 lb | 0.001 lb 0.02 lb 0.5 lb 15 lb 105 lb 250 lb | Standard weights Class F; Load cells |

V. Thermodynamic

| Parameter/Equipment | Range | CMC ² (±) | Comments |
|----------------------|-------------------------------|----------------------|---------------------------------|
| Temperature – | | | |
| Thermometers | (0 -80) °C | 0.025 °C | Hart Scientific SPRT 5614 |
| Thermocouples | (-20 to 0) °C | 0.05 °C | |
| Indicators | (0 to 650) °C | 0.25 °C | Fluke 9143, 9144, 7526A,1529 |
| Controllers | (-250 to 1800) °C | 0.7 °C | Vaisala-HMP75 |
| Relative Humidity – | | | |
| Thermohygrometer | (5 to 90) % RH Up to 40 °C | 1 % RH 0.25 °C | Fluke 9132,9133 black body |
| Infrared Thermometer | (-20 to 500) °C | (2.2) °C | |

VI. Time and Frequency

| Parameter/Equipment | Range | CMC ^{2,5} (±) | Comments |
|----------------------|---------------------------------|------------------------|----------------------|
| Frequency – Measure | (1 to 40) Hz 40 Hz to 10 MHz | 0.03 % 0.01 % | Agilent 3458 |
| Frequency – Generate | 0.01 Hz to 2 MHz | 0.25 mHz/Hz + 5 µHz | Fluke 5522A |
| Stop Watch & Timers | 24 Hours | 2.5 s | Cole Parmer-94463-30 |

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

² Calibration and Measurement Capability Uncertainty (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. 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 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 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.

⁵ In the statement of CMC, percentages are percentage of reading, unless otherwise indicated.



Accredited Laboratory

A2LA has accredited

LAW CALIBRATION, LLC

Saco, ME

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, ANSI/NCSL Z540-1-1994 and ANSI/NCSL Z540.3-2006. 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 6th day of June 2018.

A handwritten signature in black ink, written over a horizontal line.

President and CEO
For the Accreditation Council
Certificate Number 2398.01
Valid to February 29, 2020

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