



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

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CALIBRATION

Valid To: June 30, 2013

Certificate Number: 2594.01

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

I. Acoustical Quantities

| Parameter/Equipment | Range | CMC ² (±) | Comments |
|---------------------------------|-------------------------------------|----------------------|-------------------------------|
| Acoustics – Measure | 20 Hz to 8 kHz 250 Hz reference | 0.16 dB 0.16 dB | Standard reference microphone |
| Acoustics – Measuring Equipment | 124 dB @ 250 Hz | 0.20 dB | Standard pistonphone |
| | 114 dB @ 1 kHz 94 dB @ 1 kHz | 0.12 dB 0.12 dB | Acoustical calibrator |
| | 20 Hz to 50 kHz 20 Hz to 200 kHz | 0.45 dB 0.50 dB | Electrostatic actuator |

II. Dimensional

| Parameter/Equipment | Range | CMC ^{2,4} (±) | Comments |
|-----------------------|------------------|------------------------|-------------|
| Calipers ⁶ | (0.001 to 24) in | 14 μin/in + 0.6R | Gage blocks |

| Parameter/Equipment | Range | CMC ^{2, 4} (±) | Comments |
|--|------------------------------------|-------------------------|-------------------------------------|
| Indicators ⁶ | (0.001 to 6) in | 14 µin/in + 0.6R | Gage blocks |
| Micrometers – Outside ⁶ | (0.001 to 24) in | 14 µin/in + 0.6R | Gage blocks |
| Height Gages ⁶ | (0.001 to 24) in | 14 µin/in + 0.6R | Gage blocks |
| Angle – Measuring Equipment ⁶ | Up to 180° | 0.014° | Angle generator with rotating table |
| Flatness of Anvils and Spindles ⁶ | Up to 1 in diameter | 3.5 µin | Optical flats |
| Linear Displacement | (Up to 150) mm (150 to 2100) mm | 0.35 mm 0.62 mm | Linear encoder |

III. Electrical – DC/Low Frequency

| Parameter/Equipment | Range | CMC ² (±) | Comments |
|--|--|--|----------------------|
| DC Voltage ^{3, 6} – Generate | (0 to 220) mV | 6.8 µV/V + 0.40 µV | Precision calibrator |
| | 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V | 3.7 µV/V + 0.75 µV 4.9 µV/V + 2.9 µV 4.9 µV/V + 4.3 µV 3.7 µV/V + 48 µV 4.7 µV/V + 0.48 mV | |
| Fixed Point | 10 V 1 V | 5.7 µV 0.81 µV | DC voltage reference |
| DC Voltage ^{3, 6} – Measure | (0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1000) V | 9.5 µV/V + 0.37 µV 6.2 µV/V + 0.37 µV 5.8 µV/V + 0.59 µV 8.7 µV/V + 37 µV 8.7 µV/V + 0.12 mV | Precision DMM |

| Parameter/Equipment | Range | CMC ^{2,5} (±) | Comments |
|---|--|---|---|
| DC Current ^{3,6} – Generate | (0.1 to 220) μ A 220 μ A to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A (2.2 to 11) A | 36 μ A/A + 6.0 nA 31 μ A/A + 7.1 nA 30 μ A/A + 41 nA 42 μ A/A + 0.71 μ A 77 μ A/A + 12 μ A 0.034 % + 0.48 mA | Precision calibrator w/amplifier |
| | (11 to 20) A | 0.010 % + 0.91 mA | |
| | (20 to 150) A (150 to 1000) A | 0.58 % + 0.16 A 0.60 % + 0.58 A | w/coil |
| DC Current ^{3,6} – Measure | (10 to 100) μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A | 17 μ A/A + 0.80 nA 17 μ A/A + 5.0 nA 17 μ A/A + 50 nA 31 μ A/A + 0.50 μ A 0.010 % + 10 μ A | Precision DMM |
| | (1 to 10) A (10 to 100) A (30 to 300) A | 43 μ A/A 0.010 % 77 μ A/A | Current shunts |
| | (300 to 500) A | 0.061 % | |
| | | | |
| Resistance ^{3,6} – Generate, Fixed Points | 0 Ω 1 Ω 1.9 Ω (10, 19) Ω (100, 190) Ω (1, 1.9) k Ω 10, 19) k Ω (100, 190) k Ω 1 M Ω 1.9 M Ω 10 M Ω 19 M Ω 100 M Ω | 41 $\mu\Omega$ 80 $\mu\Omega/\Omega$ + 6.3 $\mu\Omega$ 80 $\mu\Omega/\Omega$ + 12 $\mu\Omega$ 21 $\mu\Omega/\Omega$ + 0.12 m Ω 21 $\mu\Omega/\Omega$ + 1.2 m Ω 7.5 $\mu\Omega/\Omega$ + 0.058 Ω 7.5 $\mu\Omega/\Omega$ + 0.58 Ω 9.0 $\mu\Omega/\Omega$ + 0.90 Ω 15 $\mu\Omega/\Omega$ + 5.0 Ω 16 $\mu\Omega/\Omega$ + 13 Ω 31 $\mu\Omega/\Omega$ + 70 Ω 39 $\mu\Omega/\Omega$ + 0.16 k Ω 95 $\mu\Omega/\Omega$ + 0.84 k Ω | Precision calibrator |
| | 1 Ω 10 k Ω | 2.5 $\mu\Omega/\Omega$ 2.4 $\mu\Omega/\Omega$ | Precision resistors |

| Parameter/Equipment | Frequency | CMC ^{2, 5} (±) | Comments |
|--------------------------------------|---|--|-----------------------|
| Resistance ^{3, 6} – Measure | (0 to 10) Ω (10 to 100) Ω (100 to 1000) Ω (1 to 10) kΩ (10 to 100) kΩ (100 to 1000) kΩ (1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1 GΩ | 18 μΩ/Ω + 58 μΩ 12 μΩ/Ω + 0.58 mΩ 10 μΩ/Ω + 0.58 mΩ 10 μΩ/Ω + 5.8 mΩ 10 μΩ/Ω + 58 mΩ 16 μΩ/Ω + 2.4 Ω 58 μΩ/Ω + 0.12 kΩ 0.058 % + 1.2 kΩ 0.59 % + 12 kΩ | Precision DMM, 4-wire |

| Parameter/Range | Frequency | CMC ^{2, 5} (±) | Comments |
|--|--|---|----------------------|
| AC Voltage ^{3, 6} – Generate | | | |
| 2.2 mV | (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz | 0.022 % + 4 μV 85 μV/V + 4 μV 75 μV/V + 4 μV 0.018 % + 4 μV 0.046 % + 5 μV 0.090 % + 10 μV 0.12 % + 20 μV 0.25 % + 20 μV | Precision calibrator |
| 22 mV | (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz | 0.022 % + 4 μV 85 μV/V + 4 μV 75 μV/V + 4 μV 0.018 % + 4 μV 0.046 % + 5 μV 0.090 % + 10 μV 0.12 % + 20 μV 0.25 % + 20 μV | |
| 220 mV | (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz | 0.022 % + 12 μV 85 μV/V + 7 μV 75 μV/V + 7 μV 0.018 % + 7 μV 0.042 % + 17 μV 0.075 % + 20 μV 0.12 % + 25 μV 0.25 % + 45 μV | |

| Parameter/Range | Frequency | CMC ^{2, 5} (\pm) | Comments |
|---|--|---|----------------------------|
| AC Voltage ^{3, 6} – Generate (cont) | | | |
| 2.2 V | (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz | 0.022 % + 40 μ V 85 μ V/V + 15 μ V 40 μ V/V + 8 μ V 70 μ V/V + 10 μ V 0.011 % + 30 μ V 0.034 % + 80 μ V 0.090 % + 200 μ V 0.15 % + 300 μ V | Precision calibrator |
| 22 V | (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz | 0.022 % + 0.40 mV 80 μ V/V + 0.15 mV 47 μ V/V + 0.05 mV 75 μ V/V + 0.10 mV 0.013 % + 0.20 mV 0.080 % + 0.60 mV 0.42 % + 2 mV 0.70 % + 3.3 mV | w/ amplifier |
| (220 to 1100) V | 40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz | 80 μ V/V + 4.1 mV 0.013 % + 6.1 mV 0.036 % + 11 mV | |
| (220 to 750) V | (30 to 50) kHz (50 to 100) kHz | 0.036 % + 11 mV 0.13 % + 45 mV | |
| AC Voltage ⁶ – Measure | | | |
| 700 μ V to 2.2 mV | (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz | 0.17 % + 1.3 μ V 0.074 % + 1.3 μ V 0.042 % + 1.3 μ V 0.081 % + 2.0 μ V 0.12 % + 2.5 μ V 0.23 % + 4.0 μ V 0.24 % + 8.0 μ V 0.35 % + 8.0 μ V | AC measurement standard |
| (2.2 to 7) mV | (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz | 0.085 % + 3 μ V 0.037 % + 1.3 μ V 0.021 % + 1.3 μ V 0.04 % + 2.0 μ V 0.06 % + 2.5 μ V 0.12 % + 4.0 μ V 0.13 % + 8.0 μ V 0.23 % + 8.0 μ V | |

| Parameter/Range | Frequency | CMC ^{2, 5} (±) | Comments |
|---|--|--|----------------------------|
| AC Voltage ⁶ – Measure (cont) | | | |
| (7 to 22) mV | (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz | 0.029 % + 1.3 μV 0.019 % + 1.3 μV 0.011 % + 1.3 μV 0.021 % + 2.0 μV 0.031 % + 2.0 μV 0.081 % + 4.0 μV 0.089 % + 8.0 μV 0.17 % + 8.0 μV | AC measurement standard |
| (22 to 70) mV | (9.5 to 10) Hz (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz | 0.10 % + 1.5 μV 0.024 % + 2.5 μV 0.012 % + 1.5 μV 65 μV/V + 1.5 μV 0.013 % + 2.0 μV 0.026 % + 2.5 μV 0.051 % + 4.0 μV 0.067 % + 8.0 μV 0.11 % + 8.0 μV | |
| (70 to 220) mV | (9.5 to 10) Hz (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 | 0.10 % + 1.5 μV 0.021 % + 1.0 μV 85 μV/V + 1.0 μV 72 μV/V + 1.0 μV 79 μV/V + 2.0 μV 0.016 % + 2.5 μV 0.025 % + 4.0 μV 0.038 % + 8.0 μV 0.10 % + 8.0 μV | |
| (220 to 700) mV | (9.5 to 10) Hz (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 | 0.10 % + 1.5 μV 0.02 % + 1.5 μV 76 μV/V + 1.5 μV 33 μV/V + 1.5 μV 51 μV/V + 2.0 μV 79 μV/V + 2.5 μV 0.018 % + 4.0 μV 0.030 % + 8.0 μV 0.096 % + 8.0 μV | |
| 700 mV to 2.2 V | (9.5 to 10) Hz (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz | 0.10 % + 1.5 μV 0.02 % + 0.82 μV 67 μV/V + 0.82 μV 24 μV/V + 0.82 μV 48 μV/V + 0.82 μV 81 μV/V + 0.82 μV | |

| Parameter/Range | Frequency | CMC ^{2, 5} (\pm) | Comments |
|---|--|--|----------------------------|
| AC Voltage ⁶ – Measure (cont) | | | |
| 700 mV to 2.2 V | (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz | 0.019 % + 0.82 μ V 0.04 % + 0.82 μ V 0.12 % + 0.82 μ V | AC measurement standard |
| (2.2 to 7) V | (9.5 to 10) Hz | 0.10 % + 1.5 μ V | |
| | (10 to 20) Hz | 0.02 % + 0.82 μ V | |
| | (20 to 40) Hz | 67 μ V/V + 0.82 μ V | |
| | 40 Hz to 20 kHz | 24 μ V/V + 0.82 μ V | |
| | (20 to 50) kHz | 48 μ V/V + 0.82 μ V | |
| | (50 to 100) kHz | 81 μ V/V + 0.82 μ V | |
| | (100 to 300) kHz | 0.019 % + 0.82 μ V | |
| (7 to 22) V | (300 to 500) kHz | 0.04 % + 0.82 μ V | |
| | (0.5 to 1) MHz | 0.12 % + 0.82 μ V | |
| | (9.5 to 10) Hz | 0.10 % + 1.5 μ V | |
| | (10 to 20) Hz | 0.10 % + 8.2 μ V | |
| | (20 to 40) Hz | 0.020 % + 8.2 μ V | |
| | 40 Hz to 20 kHz | 68 μ V/V + 8.2 μ V | |
| | (20 to 50) kHz | 31 μ V/V + 8.2 μ V | |
| (22 to 70) V | (50 to 100) kHz | 69 μ V/V + 8.2 μ V | |
| | (100 to 300) kHz | 98 μ V/V + 8.2 μ V | |
| | (300 to 500) kHz | 0.021 % + 8.2 μ V | |
| | 500 kHz to 1 MHz | 0.05 % + 8.2 μ V | |
| | (9.5 to 10) Hz | 0.10 % + 1.5 μ V | |
| | (10 to 20) Hz | 0.10 % + 8.2 μ V | |
| | (20 to 40) Hz | 0.02 % + 8.2 μ V | |
| (70 to 220) V | 40 Hz to 20 kHz | 68 μ V/V + 8.2 μ V | |
| | (20 to 50) kHz | 31 μ V/V + 8.2 μ V | |
| | (50 to 100) kHz | 69 μ V/V + 8.2 μ V | |
| | (100 to 300) kHz | 98 μ V/V + 8.2 μ V | |
| | (300 to 500) kHz | 0.021 % + 8.2 μ V | |
| | (10 to 20) Hz | 0.02 % + 8.2 μ V | |
| | (20 to 40) Hz | 68 μ V/V + 8.2 μ V | |
| 40 Hz to 20 kHz | 31 μ V/V + 8.2 μ V | | |
| (20 to 50) kHz | 69 μ V/V + 8.2 μ V | | |
| (50 to 100) kHz | 98 μ V/V + 8.2 μ V | | |
| (100 to 300) kHz | 0.021 % + 8.2 μ V | | |
| (300 to 500) kHz | 0.05 % + 8.2 μ V | | |

| Parameter/Range | Frequency | CMC ^{2, 5} (±) | Comments |
|---|---|--|--|
| AC Voltage ⁶ – Measure (cont) | | | |
| (220 to 700) V | (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz | 0.02 % + 82 μV 99 μV/V + 82 μV 41 μV/V + 82 μV 0.013 % + 82 μV 0.05 % + 82 μV | AC measurement standard |
| (700 to 1000) V | (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz | 0.02 % + 82 μV 99 μV/V + 82 μV 41 μV/V + 82 μV 0.013 % + 82 μV 0.05 % + 82 μV | |
| AC Voltage Flatness ⁶ (Relative to 1 kHz) – | | | |
| Up to 2.2 mV | (10 to 30) Hz (30 to 120) Hz (0.12 to 1.2) kHz (1.2 to 120) kHz (120 to 500) kHz (0.5 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz | 0.10 % + 82 pV 0.050 % + 82 pV 0.050 % + 82 pV 0.050 % + 82 pV 0.070 % + 1.0 μV 0.070 % + 1.0 μV 0.070 % + 1.0 μV 0.17 % + 1.0 μV 0.30 % + 1.0 μV 0.70 % + 2.0 μV | AC measurement standard (w/ wideband option) |
| (2.2 to 7) mV | (10 to 30) Hz (30 to 120) Hz (0.12 to 1.2) kHz (1.2 to 120) kHz (120 to 500) kHz (0.5 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz | 0.10 % + 82 pV 0.050 % + 82 pV 0.050 % + 82 pV 0.050 % + 82 pV 0.070 % + 1 μV 0.070 % + 1 μV 0.070 % + 1 μV 0.10 % + 1 μV 0.17 % + 1 μV 0.37 % + 1 μV | AC measurement standard |

| Parameter/Range | Frequency | CMC ^{2, 5} (\pm) | Comments |
|---|---|--|----------------------------|
| AC Voltage Flatness ⁶ (Relative to 1 kHz) – (cont) | | | |
| (7 to 22) mV | (10 to 30) Hz (30 to 120) Hz (0.12 to 1.2) kHz (1.2 to 120) kHz (120 to 500) kHz (0.5 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz | 0.1 % + 82 pV 0.05 % + 82 pV 0.05 % + 82 pV 0.05 % + 82 pV 0.07 % + 82 pV 0.07 % + 82 pV 0.07 % + 82 pV 0.1 % + 82 pV 0.17 % + 82 pV 0.37 % + 82 pV | AC measurement standard |
| (22 to 70) mV | (10 to 30) Hz (30 to 120) Hz (0.12 to 1.2) kHz (1.2 to 120) kHz (120 to 500) kHz (0.5 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz | 0.10 % + 0.82 μ V 0.050 % + 0.82 μ V 0.050 % + 0.82 μ V 0.050 % + 0.82 μ V 0.050 % + 0.82 μ V 0.050 % + 0.82 μ V 0.050 % + 0.82 μ V 0.10 % + 0.82 μ V 0.15 % + 0.82 μ V 0.35 % + 0.82 μ V | |
| (70 to 220) mV | (10 to 30) Hz (30 to 120) Hz (0.12 to 1.2) kHz (1.2 to 120) kHz (120 to 500) kHz (0.5 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz | 0.10 % + 0.82 μ V 0.040 % + 0.82 μ V 0.040 % + 0.82 μ V 0.040 % + 0.82 μ V 0.040 % + 0.82 μ V 0.050 % + 0.82 μ V 0.050 % + 0.82 μ V 0.10 % + 0.82 μ V 0.15 % + 0.82 μ V 0.35 % + 0.82 μ V | |
| (220 to 700) mV | (10 to 30) Hz (30 to 120) Hz (0.12 to 1.2) kHz (1.2 to 120) kHz (120 to 500) kHz (0.5 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz | 0.10 % + 0.82 μ V 0.050 % + 0.82 μ V 0.050 % + 0.82 μ V 0.050 % + 0.82 μ V 0.050 % + 0.82 μ V 0.050 % + 0.82 μ V 0.050 % + 0.82 μ V 0.10 % + 0.82 μ V 0.15 % + 0.82 μ V 0.35 % + 0.82 μ V | |

| Parameter/Range | Frequency | CMC ^{2, 5} (±) | Comments |
|---|---|--|----------------------------|
| AC Voltage Flatness ⁶ (Relative to 1 kHz) – (cont) | | | |
| 700 mV to 2.2 V | (10 to 30) Hz (30 to 120) Hz (0.12 to 1.2) kHz (1.2 to 120) kHz (120 to 500) kHz (0.5 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz | 0.10 % + 8.2 μV 0.030 % + 8.2 μV 0.030 % + 8.2 μV 0.030 % + 8.2 μV 0.030 % + 8.2 μV 0.050 % + 8.2 μV 0.050 % + 8.2 μV 0.10 % + 8.2 μV 0.15 % + 8.2 μV 0.35 % + 8.2 μV | AC measurement standard |
| (2.2 to 7) V | (10 to 30) Hz (30 to 120) Hz (0.12 to 1.2) kHz (1.2 to 120) kHz (120 to 500) kHz (0.5 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz | 0.10 % + 82 μV 0.030 % + 82 μV 0.030 % + 82 μV 0.030 % + 82 μV 0.030 % + 82 μV 0.050 % + 82 μV 0.050 % + 82 μV 0.10 % + 82 μV 0.15 % + 82 μV 0.35 % + 82 μV | |
| AC Voltage ^{3, 6} – Measure | | | |
| 100 μV 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 % + 3.5 μV 0.020 % + 1.3 μV 0.030 % + 1.3 μV 0.12 % + 1.3 μV 0.58 % + 1.3 μV 4.6 % + 2.4 μV | Precision DMM |
| (10 to 100) 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 300 kHz to 1 MHz (1 to 2) MHz | 71 μV/V + 4.0 μV 71 μV/V + 2.0 μV 0.014 % + 2.0 μV 0.030 % + 2.0 μV 0.080 % + 2.0 μV 0.30 % + 10 μV 1.0 % + 10 μV 1.5 % + 10 μV | |

| Parameter/Range | Frequency | CMC ^{2, 5} (\pm) | Comments |
|--|--|--|---------------|
| AC Voltage ^{3, 6} – Measure (cont) | | | |
| 100 mV to 1 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 | 71 μ V/V + 40 μ V 71 μ V/V + 20 μ V 0.014 % + 20 μ V 0.030 % + 20 μ V 0.080 % + 20 μ V 0.30 % + 0.10 mV 1.0 % + 0.10 mV 1.5 % + 0.10 mV | Precision DMM |
| (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 | 71 μ V/V + 0.40 mV 71 μ V/V + 0.20 mV 0.014 % + 0.20 mV 0.030 % + 0.20 mV 0.080 % + 0.20 mV 0.30 % + 1.0 mV 1.0 % + 1.0 mV 1.5 % + 1.0 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 | 0.024 % + 4.7 mV 0.024 % + 2.3 mV 0.024 % + 2.3 mV 0.041 % + 2.3 mV 0.14 % + 2.3 mV 0.47 % + 12 mV 1.8 % + 12 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 | 0.47 % + 47 mV 0.47 % + 23 mV 0.07 % + 23 mV 0.14 % + 23 mV 0.35 % + 23 mV | |
| AC Current ^{3, 6} – Measure | | | |
| (5 to 100) μ A | (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz | 0.046 % + 0.035 μ A 0.18 % + 0.035 μ A 0.07 % + 0.035 μ A 0.060 % + 0.030 μ A | Precision DMM |

| Parameter/Range | Frequency | CMC ^{2, 5} (±) | Comments |
|--|---|--|----------------------|
| AC Current ^{3, 6} – Measure (cont) | | | |
| 100 µA 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 | 0.46 % + 0.035 µA 0.18 % + 0.035 µA 0.07 % + 0.035 µA 0.036 % + 0.035 µA 0.060 % + 20 µA 0.40 % + 40 µA 0.55 % + 0.15 mA | Precision DMM |
| 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 | 0.47 % + 0.035 µA 0.19 % + 0.035 µA 0.10 % + 0.035 µA 0.12 % + 0.035 µA 0.30 % + 0.20 mA 1.0 % + 0.40 mA | |
| AC Current ^{3, 6} – Generate | | | |
| (9 to 220) µA | (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz | 0.023 % + 16 nA 0.014 % + 10 nA 0.011 % + 8 nA 0.025 % + 12 nA 0.090 % + 65 nA | Precision calibrator |
| 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 | 0.023 % + 40 nA 0.014 % + 36 nA 0.011 % + 36 nA 0.025 % + 0.11 µA 0.090 % + 0.65 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 | 0.023 % + 0.41 µA 0.014 % + 0.36 µA 0.011 % + 0.36 µA 0.025 % + 0.56 µA 0.090 % + 5.0 µA | |
| (22 to 220) mA | (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz | 0.023 % + 4 µA 0.014 % + 4 µA 0.011 % + 3 µA 0.018 % + 4 µA 0.090 % + 10 µA | |
| 220 mA to 2.2 A | 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz | 0.024 % + 35 µA 0.039 % + 80 µA 0.60 % + 0.16 mA | |

| Parameter/Range | Frequency | CMC ^{2, 5} (±) | Comments |
|---|---|---|--------------------------------------|
| AC Current ^{3, 6} – Generate (cont) | | | |
| (2.2 to 11) A | 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz | 0.040 % + 0.19 mA 0.085 % + 0.39 mA 0.33 % + 0.75 mA | Precision calibrator w/ amplifier |
| (11 to 20.5) A | (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz | 0.12 % + 5.1 mA 0.15 % + 5.1 mA 3.0 % + 5.1 mA | Precision calibrator |
| Capacitance ^{3, 6} – Generate | | | |
| (0.10 to 3.299) nF (3.3 to 10.999) nF (11 to 32.999) nF (33 to 109.999) nF (110 to 329.99) nF (0.33 to 1.09999) μF (1.1 to 3.29999) μF (3.3 to 10.9999) μF (11 to 32.9999) μF (33 to 109.999) μF (110 to 329.99) μF (0.33 to 1.09999) mF (1.1 to 3.29999) mF (3.3 to 10.9999) mF (11 to 32.9999) mF (33 to 109.999) mF | 10 Hz to 10 kHz 10 Hz to 3 kHz (10 to 1000) Hz (10 to 1000) Hz (10 to 1000) Hz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz Up to 50 Hz Up to 20 Hz Up to 6 Hz Up to 2 Hz Up to 0.6 Hz Up to 0.2 Hz | 0.51 % + 12 pF 0.51 % + 12 pF 0.26 % + 0.12 nF 0.26 % + 0.12 nF 0.26 % + 1.2 nF 0.26 % + 3.1 nF 0.26 % + 12 nF 0.42 % + 31 nF 0.46 % + 0.12 μF 0.46 % + 0.12 μF 0.46 % + 0.31 μF 0.46 % + 1.2 μF 0.46 % + 3.1 μF 0.46 % + 12 μF 0.78 % + 31 μF 1.2 % + 0.12 mF | Precision calibrator |

| Parameter/Equipment | Range | CMC ^{2, 5} (±) | Comments |
|---------------------------------|---|---|----------------------|
| Oscilloscopes ^{3, 6} – | | | |
| Risetime | < 125 ps | 12 ps | Precision calibrator |
| Bandwidth | 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz | 1.9 % + 0.10 mV 2.3 % + 0.10 mV 4.2 % + 0.10 mV | |
| Distortion ^{3, 6} | 20 Hz to 20 kHz (20 to 100) kHz | 1.0 % 2.0 % | Audio analyzer |

| Parameter/Equipment | Range | CMC ^{2, 4} (\pm) | Comments |
|---|--|--|---|
| Electrical Calibration/ Simulation of Thermocouples ^{3, 6} – Measure and Generate | Type J, E, K, T, N, U Type R, S, B, C | 40 $\mu\text{C}/\text{C} + 0.045 \text{ }^\circ\text{C}$ 40 $\mu\text{C}/\text{C} + 0.087 \text{ }^\circ\text{C}$ | Precision multimeter w/ precision calibrator |
| Electrical Calibration/ Simulation of RTDs ^{3, 6} – Measure and Generate All RTD Resistances | (-200 to 800) $^\circ\text{C}$ | 0.13 $^\circ\text{C} + 0.6R$ | Precision calibrator; 4-wire |

V. Fluid Quantities

| Parameter/Equipment | Range | CMC ^{2, 5} (\pm) | Comments |
|-------------------------------------|-------------------|-------------------------------|------------------------------------|
| Volumetric Flowrate ^{3, 6} | (1 to 40) gal/min | 0.14 % | Volumetric prover and stopwatch |

VI. Mechanical

| Parameter/Equipment | Range | CMC ^{2, 4, 5} (\pm) | Comments |
|--------------------------|--|--|--|
| Balances ^{3, 6} | (1 to 500) mg 500 mg to 5 g 5 g to 10 kg | 5.6 μg 22 μg 3.2 $\mu\text{g/g}$ | Ultra class weights Class 1 weights |
| Scales ^{3, 6} | (10 to 26.1) kg 1 g to 185 kg | 31 $\mu\text{g/g} + 0.6R$ 0.015 % + 0.6R | Class 6 weights |

| Parameter/Equipment | Range | CMC ^{2,4,5} (±) | Comments |
|---|---|--|--|
| Multi-Axis Force ⁶ – Compression & Tension | (0 to 1400) lbf (100 to 1000) lbf (1000 to 2000) lbf (2000 to 5000) lbf (1000 to 10 000) lbf (2500 to 25 000) lbf (5000 to 50 000) lbf (10 000 to 100 000) lbf | 0.027 % 0.069 % + 0.45 lb 0.069 % + 0.87 lb 0.069 % + 3.3 lb 0.069 % + 6.7 lb 0.069 % + 19 lb 0.069 % + 38 lb 0.069 % + 75 lb | Deadweight Load frame with load cells |
| Torque ^{3,6} – Tools | (15 to 150) in·lbf (10 to 100) ft·lbf (100 to 600) ft·lbf | 1.1 in·lbf 0.37 ft·lbf 1.9 ft·lbf | Torque calibrator |
| Torque – Transducers/ Dynamometers | (10 to 100) in·lb (100 to 1000) in·lb (1 to 3100) in·lb (1 to 10 000) in·lb (5 to 50 000) in·lb (50 to 100 000) in·lb | 0.035 % 0.035 % 0.034 % 0.069 % + 12 in·lb 0.069 % + 59 in·lb 0.069 % + 120 in·lb | Class 6 weights and torque arms Calibrator w/ torque cell |
| Pressure ^{3,6} – Transducers and Gages | (2.5 to 300) psia (300 to 1000) psia Up to 1500 psig (1500 to 3000) psig (3000 to 6000) psig | 0.011 % 0.012 % 0.21 psig 0.012 % + 0.08 psig 0.012 % + 0.12 psig | Pressure calibrator |
| Accelerometers | 100 Hz (ref) (5 to < 100) Hz 159 Hz (ref) ≥ 100 Hz to 1000 kHz ≥ 1000 Hz to 10 000 kHz | 1.7 % 2.9 % 1.8 % 2.1 % 2.5 % | Vibration transducer calibration system |
| Optical Velocity Sensors – Velocity Distance Sensing | (0.2 to 180) km/h | 0.28 % of full scale | Speed and distance simulation with a rotating drum |
| Angular Velocity – Rate Tables | Up to 2000°/s | 0.029 % + 0.0020° | Rate table calibration system |

VII. Thermodynamics

| Parameter/Equipment | Range | CMC ^{2,5} (\pm) | Comments |
|--|-----------------------------------|------------------------------|-------------------------|
| Temperature ^{3,6} – Measure | (-200 to 420) °C | 0.0038 % + 0.068 °C | Precision DMM w/PRT |
| Temperature ^{3,6} – Measuring Equipment | (50 to 425) °C (425 to 700) °C | 0.38 °C 0.56 °C | Drywell |
| Relative Humidity ^{3,6} – Measure | (10 to 95) % RH | 1.3 % RH | Electronic psychrometer |

VII. Time and Frequency

| Parameter/Equipment | Range | CMC ^{2,4} (\pm) | Comments |
|--|------------------|------------------------------|------------------------|
| Frequency – Measuring Equipment ^{3,6} | 1 mHz to 21 MHz | 5 parts in 10^{12} + 0.6R | GPS w/signal generator |
| Frequency ^{3,6} – Measure | 1 mHz to 225 MHz | 5 parts in 10^{12} + 0.6R | GPS w/counter |

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

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

³ Field calibration service is available for this calibration and this laboratory meets A2LA R104 – *General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for these calibrations. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the actual uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.

⁴ In the statement of CMC, R is the numerical value of the resolution of the device measured in its respective units.

⁵ In the statement of CMC, percentages are to be read as percentage of reading, unless otherwise indicated.

⁶ This accreditation covers the main laboratory listed above and the satellite laboratory listed below. All calibrations performed at the satellite laboratory are performed by technicians employed by the main laboratory and operate under the same quality management and technical system. The satellite laboratory is located at the following address:

DYNAMIC TECHNOLOGY, INC.
OPERATIONAL SUPPORT SERVICES DIV.
30500 Mound Road
Warren, MI 48090