



SCOPE OF ACCREDITATION TO ISO 17025:2005

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CALIBRATION

Valid To: June 30, 2018

Certificate Number: 2133.01

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

I. Dimensional

| Parameter/Equipment | Range | CMC ^{2,4} (±) | Comments |
|--|--------------------------------|-----------------------------|-------------------------------------|
| Gage Blocks – Length | Up to 1 in (Over 1 to 6) in | 3.6 µin (5.0 + 0.5L) µin | P&W Labmaster™ & master gage blocks |
| Hand Tools – Angular Measurement ³ | Up to 180 Degrees | 76 sec | Angle blocks |
| Micrometers ³ – Inside, Outside, Depth | Up to 20 in | (0.6R + 10L) µin | Gage blocks |
| Calipers ³ – Outside, Inside, Depth and End Face | Up to 48 in | (0.6R + 5.0L) µin | Gage blocks |
| Dial Indicators ³ | (0.015 to 4) in | 0.6R | P&W model C Supermicrometer™ |
| Height Gages ³ | (1 to 24) in | (65 + 1.0L) µin | Gage blocks |

| Parameter/Equipment | Range | CMC ^{2,4} (±) | Comments |
|-----------------------------------|---|--------------------------|---|
| Plug/Pin Gages | (0.005 to 10) in | (22 + 10D) μin | P&W universal Supermicrometer™, grade 1 gage blocks |
| Plain Rings | (0.25 to 9) in | (20 + 7.0D) μin | P&W universal Supermicrometer™, grade 1 gage blocks |
| Tape Measure ³ (Steel) | Up to 100 ft | 0.037 in | Gage blocks and reference ruler |
| Rulers ³ | Up to 40 in | 0.013 in | Gage blocks and reference ruler |
| Generic Test Fixtures – | | | |
| Linear Measurement | Up to 10 in | 36 μin | P & W Model C™ |
| | Up to 7 in | 150 μin | Optical comparator |
| Angular Measurement | (0 to 360)° | 10 minutes | Optical comparator |
| Radius Measurement | Up to 7 in | 240 μin | Optical comparator |
| Volumetric | (18 x 20 x 16) in | 530 μin | CMM |
| X, Y, Z Linear | (18 x 20 x 16) in | 340 μin | CMM |
| Thread Plug Gages | Up to 2 in (2 to 8) in | 73 μin (73 + 18D) μin | Measurement over wires |
| Surface Plates ³ | | | |
| Flatness | (20 to 70) in Diagonal (80 to 161) in Diagonal | (45 + 1D) μin 160 μin | Planakator |
| Repeat Reading | Up to 0.001 in | 25 μin | Repeatometer |

II. Electrical – DC/Low Frequency

| Parameter/Equipment | Range | CMC ^{2, 5, 6} (±) | Comments |
|------------------------------------|--|---|----------------------------------|
| DC Voltage ³ – Measure | Up to 200 mV 200 mV to 2V (2 to 20) V (20 to 200) V (200 to 1000) V | 4.5 μV/V + 0.1 μV 3.3 μV/V + 0.4 μV 3.3 μV/V + 4.0 μV 5.8 μV/V + 40 μV 5.8 μV/V + 0.5 mV | Fluke 8508A/01 |
| | (1 to 10) kV | 0.18 % | HP 3456A w/ divider |
| DC Voltage ³ – Generate | Up to 220 mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V | 7.8 μV/V + 0.4 μV 5.3 μV/V + 0.7 μV 4.0 μV/V + 2.5 μV 5.4 μV/V + 4.0 μV 6.6 μV/V + 40 μV 7.7 μV/V + 400 μV | Fluke 5720A/03 |
| | Fixed Point 10 V | 2.0 parts in 10 ⁶ V | Fluke 7000 & 7000N |
| DC Current ³ – Measure | Up to 200 μA 200 μA to 2 mA (2 to 20) mA (20 to 200) mA 200 mA to 2.0 A (2 to 20) A | 37 μA/A + 0.4 nA 13 μA/A + 4.0 nA 14 μA/A + 40 nA 48 μA/A + 0.8 μA 0.018 % + 16 μA 0.039 % + 400 μA | Fluke 8508A/01 |
| DC Current ³ – Generate | Up to 220 μA 220 μA to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A | 42 μA/A + 6.0 nA 41 μA/A + 7.0 nA 37 μA/A + 40 nA 47 μA/A + 10 μA 81 μA/A + 49 μA | Fluke 5720A |
| | (2.2 to 10) A | 0.037 % + 480 nA | w/ 5725A |
| | (10 to 20) A (20 to 1000) A | 21 mA 0.65 % | Fluke 5520 Fluke 5520 w/ coil |

| Parameter/Range | Frequency | CMC ^{2,6} (±) | Comments |
|-----------------------------------|------------------|---|--|
| Inductance – Generate | | | |
| 100 μH 1 mH 10 mH 100 mH | 100 Hz to 10 kHz | 0.26 μH 0.0011 mH 0.011 mH 0.11 mH | General Radio 1482-x standard inductors |
| 1 H 10 H | 100 Hz to 1 kHz | 0.0011 H 0.011 H | |

| Parameter/Equipment | Range | CMC ^{2,5,6} (±) | Comments |
|------------------------------------|--|---|----------------------------------|
| Resistance ³ – Measure | Up 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 (2 to 20) MΩ (20 to 200) MΩ 200 MΩ to 2 GΩ | 18 μΩ/Ω + 4 μΩ 11 μΩ/Ω + 14 μΩ 9.0 μΩ/Ω + 50 μΩ 9.2 μΩ/Ω + 0.5 mΩ 9.3 μΩ/Ω + 5 mΩ 9.5 μΩ/Ω + 50 mΩ 12 μΩ/Ω + 1 Ω 31 μΩ/Ω + 100 Ω 0.013 % + 10 kΩ 0.063 % + 1 MΩ | Fluke 8508A |
| | (1 to 10) kΩ | 1.0 parts in 10 ⁶ Ω | Thomas 1 Ω and Guildline 9975 |
| Resistance ³ – Generate | Up to 11 Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω 330 Ω to 1.1 kΩ (1.1 to 3.3) kΩ (3.3 to 11) kΩ (11 to 33) kΩ (33 to 110) kΩ (110 to 330) kΩ 330 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 MΩ to 1.1 GΩ | 42 μΩ/Ω + 0.001 Ω 32 μΩ/Ω + 0.0015 Ω 30 μΩ/Ω + 0.0014 Ω 29 μΩ/Ω + 0.002 Ω 30 μΩ/Ω + 0.002 Ω 29 μΩ/Ω + 0.02 Ω 30 μΩ/Ω + 0.02 Ω 30 μΩ/Ω + 0.2 Ω 30 μΩ/Ω + 0.2 Ω 34 μΩ/Ω + 2 Ω 34 μΩ/Ω + 2 Ω 65 μΩ/Ω + 30 Ω 0.014 % 0.034 % 0.055 % 0.35 % 1.6 % | Fluke 5520A |

| Parameter/Equipment | Range | CMC ^{2,5,6} (±) | Comments |
|------------------------------------|--|---|-------------|
| Resistance ³ – Generate | | | |
| Fixed Points | 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ | 96 μΩ/Ω 96 μΩ/Ω 24 μΩ/Ω 28 μΩ/Ω 11 μΩ/Ω 11 μΩ/Ω 9.3 μΩ/Ω 9.4 μΩ/Ω 10 μΩ/Ω 10 μΩ/Ω 13 μΩ/Ω 13 μΩ/Ω 22 μΩ/Ω 23 μΩ/Ω 42 μΩ/Ω 62 μΩ/Ω 0.011 % | Fluke 5720A |
| | 1 Ω | 0.7 μΩ/Ω | Thomas 1 Ω |

| Parameter/Range | Frequency | CMC ^{2,5,6} (±) | Comments |
|------------------------------------|---|---|-------------|
| AC Current ³ – Generate | | | |
| Up to 220 μA | (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz | 0.029 % + 16 nA 0.019 % + 10 nA 0.015 % + 8 nA 0.035 % + 12 nA 0.12 % + 65 nA | Fluke 5720A |
| (0.22 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 | 0.027 % + 40 nA 0.018 % + 35 nA 0.015 % + 35 nA 0.03 % + 110 nA 0.12 % + 650 nA | |
| (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 | 0.029 % + 400 nA 0.019 % + 350 nA 0.017 % + 350 nA 0.023 % + 550 nA 0.12 % + 5 μA | |

| Parameter/Range | Frequency | CMC ^{2,5,6} (\pm) | Comments |
|--|---|---|--------------------------|
| AC Current ³ – Generate (cont) | | | |
| (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 | 0.029 % + 4.0 μ A 0.021 % + 3.5 μ A 0.018 % + 2.5 μ A 0.024 % + 3.5 μ A 0.12 % + 10 μ A | Fluke 5720A |
| 220 mA to 2.2 A | (20 to 1000) Hz (1 to 5) kHz (5 to 10) kHz | 0.029 % + 35 μ A 0.047 % + 80 μ A 0.74 % + 160 μ A | w/ 5725A |
| (2.2 to 11) A | (40 to 1000) Hz (1 to 5) kHz (5 to 10) kHz | 0.049 % + 170 μ A 0.097 % + 380 μ A 0.37 % + 750 μ A | Fluke 5720A w/ 5725A |
| (11 to 20.5) A | (45 to 100) Hz 100 Hz to 1 kHz | 0.15 % + 5 mA 0.22 % + 5 mA | Fluke 5520A LCOMP off |
| (20.5 to 1000) A | (45 to 65) Hz | 0.27 % + 5 mA | Fluke 5520 & coil |
| AC Current ³ – Measure | | | |
| Up to 200 μ A | (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz | 0.033 % + 20 nA 0.05 % + 20 nA 0.075 % + 20 nA 0.47 % + 20 nA | Fluke 8508A |
| 200 μ A to 2 mA | (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz | 0.032 % + 200 nA 0.031 % + 200 nA 0.081 % + 200 nA 0.42 % + 200 nA | |
| (2 to 20) mA | (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz | 0.032 % + 2 μ A 0.043 % + 2 μ A 0.076 % + 2 μ A 0.42 % + 2 μ A | |
| (20 to 200) mA | (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz | 0.032 % + 20 μ A 0.031 % + 20 μ A 0.085 % + 20 μ A | |

| Parameter/Range | Frequency | CMC ^{2, 5, 6} (±) | Comments |
|---|--|--|-------------|
| AC Current ³ – Measure (cont) | | | |
| 200 mA to 2 A | 10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz | 0.063 % + 200 µA 0.074 % + 200 µA 0.31 % + 200 µA | Fluke 8508A |
| (2 to 20) A | 10 Hz to 2 kHz (2 to 10) kHz | 0.083 % + 2 mA 0.26 % + 2 mA | |
| AC Voltage ³ – Generate | | | |
| Up 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 | 0.028 % + 4 µV 94 µV/V + 4 µV 84 µV/V + 4 µV 0.03 % + 4 µV 0.06 % + 5 µV 0.12 % + 10 µV 0.15 % + 20 µV 0.28 % + 20 µV | Fluke 5720A |
| (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 | 0.028 % + 4 µV 94 µV/V + 4 µV 84 µV/V + 4 µV 0.03 % + 4 µV 0.06 % + 5 µV 0.12 % + 10 µV 0.15 % + 20 µV 0.28 % + 20 µV | |
| (22 to 220) mV | (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz | 0.028 % + 12 µV 94 µV/V + 7 µV 84 µV/V + 7 µV 0.03 % + 7.0 µV 0.06 % + 17 µV 0.12 % + 20 µV 0.15 % + 25 µV 0.28 % + 45 µV | |
| (0.22 to 2.2) V | (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz | 0.028 % + 40 µV 94 µV/V + 15 µV 48 µV/V + 8 µV 79 µV/V + 10 µV 0.02 % + 300 µV 0.05 % + 80 µV 0.14 % + 200 µV 0.21 % + 300 µV | |

| Parameter/Range | Frequency | CMC ^{2,5,6} (±) | Comments |
|---|--|---|--|
| AC Voltage ³ (cont)– Generate | | | |
| (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 | 0.028 % + 400 μV 95 μV/V+ 150 μV 54 μV/V + 50 μV 90 μV/V + 100 μV 0.02 % + 200 μV 0.035 % + 600 μV 0.14 % + 2 mV 0.19 % + 3.2 mV | Fluke 5720A |
| (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 | 0.028 % + 4 mV 0.012 % + 1.5 mV 62 μV/V + 0.6 mV 90 μV/V + 1 mV 0.018 % + 2.5 mV 0.091 % + 16 mV 0.48 % + 40 mV 0.85 % + 80 mV | Fluke 5720A, Volt-Hertz limitation over 100 kHz, Max output is 2.2 x 10 ⁷ V-Hz. |
| (220 to 1100) V | (15 to 50) Hz 50 Hz to 1 kHz | 0.031 % + 16 mV 0.008 % + 3.5 mV | Max 250 V for (15 to 50) Hz |
| (220 to 1100) V | (1 to 20) kHz (20 to 30) kHz | 0.017 % + 6 mV 0.062 % + 11 mV | Fluke 5720A w/ 5725A |
| (220 to 750) V | (30 to 50) kHz (50 to 100) kHz | 0.062 % + 11 mV 0.24 % + 45 mV | |

| Parameter/Range | Frequency | CMC ^{2,5,6} (±) | Comments |
|--|--|--|----------------|
| AC Voltage – Measure | | | |
| 600 µV to 2.2 mV | (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz | 0.22 % + 1.3 µV 0.079 % + 1.3 µV 0.048 % + 1.3 µV 0.088 % + 2.0 µV 0.14 % + 2.5 µV 0.26 % + 4.0 µV 0.27 % + 8.0 µV | Fluke 5790A/03 |
| Flatness – 500 kHz to 30 MHz (Relative to 1 kHz) | 500 kHz to 1.2 MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz | 0.08 % + 1.0 µV 0.08 % + 1.0 µV 0.19 % + 1.0 µV 0.4 % + 1.0 µV 0.75 % + 2.0 µV | |
| (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 | 0.092 % + 1.3 µV 0.042 % + 1.3 µV 0.025 % + 1.3 µV 0.06 % + 2.0 µV 0.08 % + 2.5 µV 0.16 % + 4.0 µV 0.17 % + 8.0 µV | |
| Flatness – 500 kHz to 30 MHz (Relative to 1 kHz) | 500 kHz to 1.2 MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz | 0.08 % + 1.0 µV 0.08 % + 1.0 µV 0.19 % + 1.0 µV 0.4 % + 1.0 µV 0.75 % + 1.0 µV | |
| (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 | 0.033 % + 1.3 µV 0.021 % + 1.3 µV 0.014 % + 1.3 µV 0.025 % + 2.0 µV 0.035 % + 2.5 µV 0.086 % + 4.0 µV 0.092 % + 8.0 µV | |
| Flatness – 500 kHz to 30 MHz (Relative to 1 kHz) | 500 kHz to 1.2 MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz | 0.08 % 0.08 % 0.19 % 0.4 % 0.75 % | |

| Parameter/Range | Frequency | CMC ^{2,5,6} (±) | Comments |
|--------------------------------|--|--|----------------|
| AC Voltage (cont) – Measure | | | |
| (22 to 70) mV | (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz | 0.028 % + 1.5 μV 0.017 % + 1.5 μV 75 μV/V + 1.5 μV 0.017 % + 2 μV 0.032 % + 2.5 μV 0.057 % + 4 μV 0.075 % + 8 μV | Fluke 5790A/03 |
| (70 to 220) mV | (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz | 0.023 % + 1.5 μV 95 μV/V + 1.5 μV 47 μV/V + 1.5 μV 75 μV/V + 2 μV 0.019 % + 2.5 μV 0.028 % + 4 μV 0.042 % + 8 μV | |
| (220 to 700) mV | (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz | 0.024 % + 1.5 μV 81 μV/V + 1.5 μV 40 μV/V + 1.5 μV 56 μV/V + 2 μV 98 μV/V + 2.5 μV 0.024 % + 4 μV 0.05 % + 8 μV | |
| 700 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 | 0.03 % 68 μV/V 29 μV/V 53 μV/V 79 μV/V 0.019 % 0.031 % | |

| Parameter/Range | Frequency | CMC ^{2,5,6} (±) | Comments |
|--------------------------------|--------------------|--------------------------|----------------|
| AC Voltage (cont) – Measure | | | |
| 22 mV to 7 V | 500 kHz to 1.2 MHz | 0.06 % | Fluke 5790A/03 |
| | (1.2 to 2) MHz | 0.06 % | |
| Flatness – | (2 to 10) MHz | 0.12 % | |
| 500 kHz to 30 MHz | (10 to 20) MHz | 0.17 % | |
| (Relative to 1 kHz) | (20 to 30) MHz | 0.38 % | |
| (2.2 to 7) V | (10 to 20) Hz | 0.03 % | |
| | (20 to 40) Hz | 73 μV/V | |
| | 40 Hz to 20 kHz | 28 μV/V | |
| | (20 to 50) kHz | 56 μV/V | |
| | (50 to 100) kHz | 90 μV/V | |
| | (100 to 300) kHz | 0.03 % | |
| | (300 to 500) kHz | 0.06 % | |
| Flatness – | (10 to 30) Hz | 0.12 % | |
| 10 Hz to 500 kHz | 2.2 mV to 7 V | | |
| (Relative to 1 kHz) | (30 to 120) kHz | 0.059 % | |
| | 2.2 mV to 7 V | | |
| | (120 to 500) kHz | 0.12 % | |
| | (2.2 to 22) mV | | |
| | (120 to 500) kHz | 0.077 % | |
| | (22 to 70) mV | | |
| | (120 to 500) kHz | 0.059 % | |
| | (70 to 220) mV | | |
| | (120 to 500) kHz | 0.045 % | |
| | (220 to 700) mV | | |
| | (120 to 500) kHz | 0.035 % | |
| | 700 mV to 7 V | | |

| Parameter/Range | Frequency | CMC ^{2,5,6} (±) | Comments | |
|-----------------------------|--|--|----------------|---------------------|
| AC Voltage (cont) – Measure | | | | |
| (7 to 22) V | (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz | 0.03 % 69 μV/V 30 μV/V 53 μV/V 90 μV/V 0.022 % 0.045 % | Fluke 5790A/03 | |
| (22 to 70) 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 | 0.03 % 73 μV/V 36 μV/V 62 μV/V 100 μV/V 0.024 % 0.05 % 0.14 % | | |
| (70 to 220) V | (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz | 0.03 % 73 μV/V 36 μV/V 73 μV/V 0.011 % 0.03 % 0.06 % | | |
| (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 | 0.03 % 0.013 % 46 μV/V 0.015 % 0.06 % | | |
| (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 | 0.03 % 0.013 % 50 μV/V 0.015 % 0.06 % | | |
| (1 to 10) kV | (45 to 65) Hz | 0.85 % | | HP 3456A w/ divider |
| Capacitance – Measure | | | | |
| 100 pf to 1000 μf | 12.5 Hz to 10 kHz | 0.18 % | Genrad 1689 | |

| Parameter/Equipment | Range | CMC ^{2,5,6} (±) | Comments |
|--|--|---|-------------|
| Phase ³ – Generate | (10 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz | 0.1° 0.25° 0.5° 2.5° 5° 10° | Fluke 5520A |
| Capacitance ³ – Generate | (0.19 to 3.3) nF (3.3 to 11) nF (11 to 110) nF (110 to 330) nF (0.33 to 1.1) μF (1.1 to 3.3) μF (3.3 to 11) μF (11 to 33) μF (33 to 110) μF (110 to 330) μF (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 | 0.6 % + 0.01 nF 0.33 % + 0.01 nF 0.26 % + 0.1 nF 0.26 % + 0.3 nF 0.28 % + 1 nF 0.26 % + 3 nF 0.28 % + 10 nF 0.42 % + 30 nF 0.47 % + 100 nF 0.47 % + 300 nF 0.45 % + 1 μF 0.47 % + 3 μF 0.47 % + 10 μF 0.78 % + 30 μF 1.3 % + 100 μF | Fluke 5520A |
| Electrical Simulation of Thermocouples ³ – | | | |
| Type B | (600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C | 0.44 °C 0.34 °C 0.3 °C 0.33 °C | Fluke 5520A |
| Type C | (0 to 150) °C (150 to 650) °C (650 to 1000) °C (1000 to 1800) °C (1800 to 2316) °C | 0.3 °C 0.26 °C 0.31 °C 0.5 °C 0.84 °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 | |

| Parameter/Equipment | Range | CMC ² (±) | Comments |
|--|--|---|-------------|
| Electrical Simulation of Thermocouples ³ (cont) – | | | |
| 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 | Fluke 5520A |
| Type K | (-200 to -100) °C (-100 to -25) °C (-25 °C 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 | |
| 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 | |

| Parameter/Equipment | Range | CMC ^{2,5} (±) | Comments |
|---|--|---|-------------|
| Electrical Simulation of RTD 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 | 0.052 °C 0.072 °C 0.092 °C 0.13 °C 0.13 °C | Fluke 5520A |
| Pt 3926, 100 Ω | (-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C | 0.052 °C 0.072 °C 0.092 °C 0.11 °C 0.13 °C | |
| Pt 3916, 100 Ω | (-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C | 0.26 °C 0.041 °C 0.051 °C 0.061 °C 0.072 °C 0.082 °C 0.092 °C 0.11 °C 0.24 °C | |
| AC Power, Low Frequency ³ – | | | |
| 3.3 mA to 21 A (45 to 65) Hz | (33 to 330) mV (0.33 to 1020) V | 0.16 % 0.14 % | Fluke 5520A |
| DC Power ³ – | | | |
| (0.33 to 30) mA (0.33 to 3) A (3 to 21) A | 33 mV to 1020 V 33 mV to 1020 V 33 mV to 1020 V | 0.025 % 0.024 % 0.09 % | Fluke 5520A |

| Parameter/Equipment | Range | CMC ^{2,5,6} (±) | Comments |
|--------------------------------------|-------------------------------|-----------------------------|-------------------|
| Oscilloscope ³ – | | | |
| Squarewave Signal | | | |
| (50 Ω at 1 kHz) | 1 mV to 6.6 V | 0.28 % + 48 μV | Fluke 5520A/SC600 |
| (1 MΩ at 1 kHz) | 1 mV to 130 V | 0.12 % + 48 μV | |
| Leveled Sine Wave | | | |
| Amplitude | 50 kHz reference | 2.4 % + 300 μV | |
| | 50 kHz to 100 MHz | 4.2 % + 300 μV | |
| | (100 to 300) MHz | 4.7 % + 300 μV | |
| | (300 to 600) MHz | 7 % + 300 μV | |
| | (600 to 3200) MHz | 7.7 % + 300 μV | Fluke 9500B/9530 |
| Flatness (rel. to 50 kHz) | 50 kHz to 100 MHz | 1.8 % + 100 μV | Fluke 5520A/SC600 |
| | (100 to 300) MHz | 2.5 % + 100 μV | |
| | (300 to 600) MHz | 4.7 % + 100 μV | |
| | (600 to 3200) MHz | 7 % + 100 μV | Fluke 9500B/9530 |
| Time Marker (50 Ω Source and Period) | 5 s to 50 ms 20 ms to 2 ns | 26 ns + 0.07 ms 2.6 μs/s | Fluke 5520A/SC600 |
| Rise Time | ≤ 350 ps | +0 / -100 ps | |

III. Fluid Quantities

| Parameter/Equipment | Range | CMC ^{2,5} (±) | Comments |
|--------------------------|---------------------|------------------------|---|
| Liquid Flow ³ | (0 to 15) GPM water | 0.25 % | Direct comparison using micro motion flow meter |

IV. Mechanical

| Parameter/Equipment | Range | CMC ^{2,5} (±) | Comments |
|---|--|---|--|
| Pressure, Nitrogen ³ – Gage/ABS | (0.2 to 25) psi (1.7 to 100) psi (2 to 1000) psi | 20 parts in 10 ⁶ psi | Ruska piston gage |
| Pressure, Hydraulic ³ | (1 k to 10 k) psi | 0.05 % + 0.10 psi | Ametek TQ-100 DWT |
| Negative Gage | (-14.5 to 0) psi | 30 parts in 10 ⁶ psi | Ruska piston gage |
| Barometric | (10 to 16) psia | 0.01 % | DHI RPM4 |
| Low | (0.01 to 2) in H ₂ O (2 to 10) in H ₂ O | 0.00034 in H ₂ O 0.0021 in H ₂ O | Micro tector Hook gage |
| Balances/Scales ³ | (1 to 500) mg (1 to 100) g (200 to 1000) g (1 to 10) kg (10 to 450) kg | 0.017 mg 0.18 mg 1.7 mg 17 mg 0.022 kg | NIST Class F, ASTM Class 1 or 2 weights |
| Mass – Weight Sets, Fixed Point | 1 mg 2 mg 3 mg 5 mg 10 mg 20 mg 30 mg 50 mg 100 mg 200 mg 300 mg 500 mg 1 g 2 g 3 g 5 g | 0.002 mg 0.002 mg 0.0022 mg 0.002 mg 0.002 mg 0.002 mg 0.0022 mg 0.002 mg 0.0021 mg 0.0021 mg 0.0024 mg 0.003 mg 0.0045 mg 0.0044 mg 0.0059 mg 0.0044 mg | Calibration to ASTM E617 by double substitution method w/ E1 & ASTM E- 617 Class 0 to 7 weights NIST Handbook 105-1 w/ Class F weights Mettler MX5 Mettler XP205 Sartorius CCE2004 Mettler XP26003L |

| Parameter/Equipment | Range | CMC ² (±) | Comments |
|---|---|--|---|
| Mass – Weight Sets, Fixed Point (cont) | 10 g 20 g 30 g 50 g 100 g 200 g 300 g 500 g 1 kg 2 kg 3 kg 5 kg 10 kg 25 kg | 0.018 mg 0.021 mg 0.022 mg 0.027 mg 0.053 mg 0.067 mg 0.15 mg 0.21 mg 0.33 mg 0.64 mg 2.7 mg 4.1 mg 5.2 mg 7.1 mg | Mettler MX5 Mettler XP205 Sartorius CCE2004 Mettler XP26003L |
| Torque | (2 to 20) in·ozf (15 to 200) in·ozf (4 to 50) in·lbf (30 to 400) in·lbf (80 to 1000) in·lbf (20 to 250) ft·lbf (100 to 1000) ft·lbf | 0.063 in·ozf 0.59 in·ozf 0.15 in·lbf 1.2 in·lbf 3.0 in·lbf 0.73 ft·lbf 2.9 ft·lbf | Arm and weights |
| Torque Wrenches | (2 to 20) in·ozf (15 to 200) in·ozf (4 to 50) in·lbf (30 to 400) in·lbf (80 to 1000) in·lbf (20 to 250) ft·lbf (100 to 1000) ft·lbf | 0.24 in·ozf 2.4 in·ozf 0.6 in·lbf 4.8 in·lbf 12 in·lbf 3 ft·lbf 12 ft·lbf | CDI torque system |
| Force – Compression | (100 to 2000) lbf (1 to 20 000) lbf (5 to 50 000) lbf (10 to 100 000) lbf | 0.29 lbf 3.1 lbf 13 lbf 20 lbf | Load cells |
| Force – Tension | (100 to 2000) lbf | 0.3 lbf | Load cells |

V. Thermodynamics

| Parameter/Equipment | Range | CMC ² (±) | Comments |
|--|--|-------------------------------------|--|
| Relative Humidity ³ | 10 % RH to 95 % RH | 2.0 % RH | Rotronic RH transmitter, Fluke Hydra data logger |
| Thermometers ³ –Measure and Measuring Equipment | (-197 to 100) °C (100 to 420) °C (-40 to 250) °F | 0.016 °C 0.028 °C 0.05 °F | Hart 1594A, SPRT |
| IR Thermometers | (-15 to 120) °C (35 to 500) °C | 1.2 °C 1.6 °C | Hart Scientific 4180 Hart Scientific 4181 |
| Welch Allyn Blackbody | (29 to 43) °C | 0.072 °C | Master blackbody, SPRT |

VI. Time & Frequency

| Parameter/Equipment | Range | CMC ^{2,5} (±) | Comments |
|---------------------------------|---------------------------------|----------------------------------|---------------|
| Frequency – Measuring Equipment | 0.01 Hz to 2 MHz | 2.6 µHz/Hz + 5 µHz | Fluke 5520A |
| Fixed Point | 10 MHz | 6.8 parts in 10 ¹⁰ Hz | Datum ET600 |
| Frequency – Measure | (1 to 40) Hz 40 Hz to 10 MHz | 0.052 % 0.011 % | Agilent 3458A |
| Stopwatches | 15 min to 24 hr | 300 ms | Datum ET6000 |

¹ This laboratory offers commercial 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. CMCs represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of $k = 2$. The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.
- ³ Field calibration service is available for this calibration and this laboratory meets A2LA R104 – *General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for these calibrations. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the actual uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.
- ⁴ In the statement of CMC, L is the numerical value of the nominal length of the device measured in inches, R is the numerical value of the resolution of the device in microinches, D is the numerical value of the nominal diameter of the device measured in inches.
- ⁵ In the statement of CMC, the value is defined as the percentage of reading.
- ⁶ 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 fraction/percentage of the reading plus a fixed floor specification.



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for technical competence in the field of

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Presented this 6th day of June 2016.

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

President and CEO
For the Accreditation Council
Certificate Number 2133.01
Valid to June 30, 2018
Revised on May 30, 2018

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