



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

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CALIBRATION

Valid To: November 30, 2024

Certificate Number: 1995.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations^{1, 11}:

I. Dimensional

| Parameter/Equipment | Range | CMC ^{2, 7} (\pm) | Comments |
|-----------------------------------|-------------------------------------------|-------------------------------------------------------------|--------------------------------------------------------|
| Gage Blocks | Up to 1 in (1 to 4) in (4 to 20) in | (3 + 4L) μ in (2 + 4L) μ in (6 + 3L) μ in | By mechanical comparison with gage blocks standards |
| Length Standards ^{3, 9} | Up to 24 in (24 to 80) in | (20 + 5L) μ in (50 + 6L) μ in | P&W 80 in LMM, Supermic TM , gage blocks |
| Bore Gages ^{3, 9} | Up to 5 in | 0.000 40 in | Master ring gages |
| Micrometers ^{3, 9} | Up to 1 in (1 to 80) in | (70 + 2L) μ in (70 + 3L) μ in | Gage blocks |
| Calipers ^{3, 9} | Up to 60 in | (600 + 8L) μ in | Gage blocks |
| Length Indicators ^{3, 9} | Up to 8 in | (60 + 60L) μ in | Gage blocks & granite plate |

| Parameter/Equipment | Range | CMC ^{2,7} (\pm) | Comments |
|----------------------------------------------------|---------------------------------------|------------------------------|-------------------------------------------|
| Ruled Standards ^{3,9} – Steel Rules | Up to 60 in | (400 + 200L) μ in | Precision rule & microscope |
| Steel Tape | Up to 100 ft | 0.016 in | Precision rule, microscope, standard tape |
| Plain Ring Gages ⁹ | (0.06 to 5) in | (10 + 9L) μ in | ULM & master rings |
| Plain Plug & Pin Gages ^{3,9} | Up to 12 in | (80 + 15L) μ in | ULM & gage blocks |
| Thread Plug Gages – Major Diameter ⁹ | Up to 5 in | 68 μ in | ULM & gage blocks |
| Pitch Diameter ⁹ | (4 to 80) pitch | 63 μ in | Thread wires |
| Coating Thickness Gages ^{3,9} | Up to 60 mils | (0.071 + 0.0061L) mils | Coating thickness standards |
| Ultrasonic Thickness Gages ^{3,9} | Up to 1 in | 0.000 59 in | Step block standards |
| Height Gages ³ | Up to 24 in | (50 + 8L) μ in | Gage blocks & surface plate |
| Surface Roughness Gauges ^{3,9} | Ra 18.9 μ in Ra 119.5 μ in | 2.4 μ in 2.4 μ in | Surface roughness specimens |

II. Electrical – DC/Low Frequency

| Parameter/Equipment | Range | CMC ^{2, 4, 6, 10} (±) | Comments |
|--------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| DC Voltage – Generate ^{3,9} | 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 | 14 µV/V + 0.4 µV 6.6 µV/V + 0.7 µV 4.4 µV/V + 2.5 µV 4.4 µV/V + 4 µV 6.4 µV/V + 40 µV 9.3 µV/V + 400 µV | Fluke 5720A calibrator |
| Fixed points | 0.1 V 1 V 10 V 100 V 1000 V | 2.2 µV/V 1.7 µV/V 0.50 µV/V 1.8 µV/V 2.2 µV/V | Datron 4910 w/ divider Datron 4910 Datron 4910 w/ divider |
| DC Voltage – Measure ^{3,9} | (0 to 200) mV 200 mV to 2 V (2 to 20) V (20 to 200) V (200 to 1050) V | 9.3 µV/V + 0.1 µV 5.7 µV/V + 0.4 µV 4.3 µV/V + 4 µV 8.3 µV/V + 40 µV 8.8 µV/V + 500 µV | Fluke 8508A Opt. 01 DMM |
| High DC Voltage – Generate & Measure ^{3,9} | (1 to 120) kV | 0.12 % | Ross VD120 HV divider w/ Agilent 34401A meter & high voltage DC source |
| DC Current – Generate ^{3,9} | 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 (2 to 20) A (20 to 120) A | 53 µA/A + 6 nA 47 µA/A + 7 nA 47 µA/A + 40 nA 57 µA/A + 0.7 µA 0.010 % + 1.2 µA 0.016 % + 0.8 mA 0.014 % + 4.8 mA | Fluke 5720A calibrator Fluke 52120A amplifier |
| Current Clamps ^{3,9} | (10 to 16.5) A (16.5 to 150) A (150 to 1025) A (0 to 5000) A | 0.25 % + 0.002 A 0.26 % + 0.015 A 0.28 % + 0.05 A 0.81 % | Fluke 5522A & 50 turn coil Fluke 52120A & 25/50 turn coil |

| Parameter/Equipment | Range | CMC ^{2, 4, 5, 6, 10} (\pm) | Comments |
|-------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| DC Current – Measure ^{3, 9} | Up to 200 μ A 200 μ A to 2 mA (2 to 20) mA (20 to 200) mA 200 mA to 2 A (2 to 20) A (1 to 50) A (50 to 100) A | 59 μ A/A + 0.4 nA 29 μ A/A + 4 nA 26 μ A/A + 40 nA 62 μ A/A + 0.8 μ A 0.027 % + 16 μ A 0.049 % + 0.4 mA 0.013 % 0.013 % | Fluke 8508A Opt. 01 DMM Ohm-Labs CS-50 shunt, Agilent 3458A Ohm-Labs CS-100 shunt Agilent 3458A |
| DC Current – Generate & Measure ³ | (100 to 1000) A | 0.25 % | Empro shunts, Agilent 3458A & current source |
| DC Power – Generate ^{3, 9} | Up to 109 μ W (0.109 to 1.09) mW (1.09 to 10.9) mW (10.9 to 109) mW (0.109 to 1.09) W (1.09 to 10.9) W (10.9 to 109) W (109 to 337) W (337 to 990) W (0.99 to 3.06) kW (3.06 to 11.2) kW (11.2 to 20.9) kW | 0.023 % 0.014 % 0.013 % 0.013 % 0.013 % 0.013 % 0.013 % 0.013 % 0.013 % 0.027 % 0.045 % 0.064 % 0.12 % | Fluke 5522A calibrator |

| Parameter/Equipment | Range | CMC ^{2, 4, 5, 6, 10} (±) | Comments |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Resistance – Generate | | | |
| Fixed Points | 0.0001 Ω 0.001 Ω 0.01 Ω 0.1 Ω 1 Ω 10 Ω 25Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ 1 GΩ | 0.25 % 0.013 % 0.013 % 11 μΩ/Ω 11 μΩ/Ω 8.1 μΩ/Ω 8.1 μΩ/Ω 8.1 μΩ/Ω 8.1 μΩ/Ω 8.1 μΩ/Ω 1.5 μΩ/Ω 11 μΩ/Ω 11 μΩ/Ω 12 μΩ/Ω 12 μΩ/Ω 0.01 % | Empro 2672 shunt Ohm-Labs CS-100 shunt Ohm-Labs CS-50 shunt ESI SR1010 1 Ω/step Fluke 742A-1 Fluke 742A-10 Fluke 742A-25 Fluke 742A-100 Fluke 742A-1K ESI SR-104 standard resistor Fluke 742A-100K Fluke 742A-1M Fluke 742A-10M ESI SR-1050 10MΩ/step Fluke 8508A-7000K |
| | 0 Ω 1.9 Ω 19 Ω 190 Ω 1.9 kΩ 19 kΩ 190 kΩ 1.9 MΩ 19 MΩ | 41 μΩ/Ω 120 μΩ/Ω 28 μΩ/Ω 14 μΩ/Ω 12 μΩ/Ω 12 μΩ/Ω 16 μΩ/Ω 28 μΩ/Ω 73 μΩ/Ω | Fluke 5720A calibrator |
| Variable Range ^{3, 9} | (0 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 Ω 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 | 51 μΩ/Ω + 0.001 Ω 35 μΩ/Ω + 0.0015 Ω 33 μΩ/Ω + 0.0014 Ω 33 μΩ/Ω + 0.002 Ω 33 μΩ/Ω + 0.002 Ω 33 μΩ/Ω + 0.02 Ω 33 μΩ/Ω + 0.02 Ω 33 μΩ/Ω + 0.2 Ω 33 μΩ/Ω + 0.2 Ω 37 μΩ/Ω + 2 Ω 38 μΩ/Ω + 2 Ω 70 μΩ/Ω + 30 Ω 0.015 % + 50 Ω 0.029 % + 2.5 kΩ 0.06 % + 3 kΩ 0.35 % + 0.1 MΩ 1.7 % + 0.5 MΩ | Fluke 5522A calibrator |

| Parameter/Equipment | Range | CMC ^{2, 4, 5, 6, 10} (\pm) | Comments |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Resistance – Measure ^{3, 9} | Up to 2 Ω (2 to 20) Ω (20 to 200) Ω 200 Ω to 2 k Ω (2 to 20) k Ω (20 to 200) k Ω 200 k Ω to 2 M Ω (2 to 20) M Ω (20 to 200) M Ω 200 M Ω to 2 G Ω (2 to 20) G Ω | 26 $\mu\Omega/\Omega$ + 4 $\mu\Omega$ 17 $\mu\Omega/\Omega$ + 14 $\mu\Omega$ 10 $\mu\Omega/\Omega$ + 50 $\mu\Omega$ 11 $\mu\Omega/\Omega$ + 0.5 m Ω 11 $\mu\Omega/\Omega$ + 5 m Ω 11 $\mu\Omega/\Omega$ + 50 m Ω 14 $\mu\Omega/\Omega$ + 1 Ω 24 $\mu\Omega/\Omega$ + 10 Ω 84 $\mu\Omega/\Omega$ + 1 k Ω 0.03 % + 0.1 M Ω 0.18 % + 10 M Ω | Fluke 8508A Opt. 01 DMM |
| Capacitance – Generate ^{3, 9} | (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 | 0.58 % + 0.01 nF 0.58 % + 0.01 nF 0.58 % + 0.01 nF 0.29 % + 0.01 nF 0.29 % + 0.1 nF 0.29 % + 0.1 nF 0.29 % + 0.3 nF 0.29 % + 1 nF 0.29 % + 3 nF 0.29 % + 10 nF 0.46 % + 30 nF 0.52 % + 0.1 μ F 0.52 % + 0.3 μ F 0.52 % + 1 μ F 0.52 % + 3 μ F 0.52 % + 10 μ F 0.87 % + 30 μ F 1.2 % + 100 μ F | Fluke 5522A Calibrator |
| Capacitance – Measure ^{3, 9} | 300 pF to 1000 nF (1 to 300) μ F (300 to 1100) μ F (1.1 to 110) mF | 0.06 % 0.12 % 0.15 % 0.33 % | GenRad 1689M RLC Digibridge 5720A w/ 3458A (output/charge current method) |

| Parameter/Equipment | Range | CMC ^{2,4} (±) | Comments |
|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-----------------------------------------------------|------------------------|
| Electrical Calibration of Thermocouple Indicators ^{3,9} – Generate & Measure | | | |
| Type E | (-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C | 0.39 °C 0.13 °C 0.12 °C 0.13 °C 0.17 °C | Fluke 5522A calibrator |
| Type J | (-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C | 0.21 °C 0.13 °C 0.12 °C 0.14 °C 0.19 °C | |
| Type K | (-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C | 0.26 °C 0.15 °C 0.13 °C 0.20 °C 0.31 °C | |
| Type N | (-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C | 0.31 °C 0.18 °C 0.16 °C 0.15 °C 0.21 °C | |
| Type R | (0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C | 0.44 °C 0.27 °C 0.26 °C 0.31 °C | |
| Type S | (0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C | 0.36 °C 0.28 °C 0.29 °C 0.36 °C | |
| Type T | (-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C | 0.49 °C 0.20 °C 0.13 °C 0.12 °C | |

| Parameter/Equipment | Range | CMC ^{2,4} (±) | Comments |
|------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|---------------------------|
| Electrical Calibration of RTD Indicator ^{3,9} – Generate Only | | | |
| Pt385, 100 Ω | (-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C | 0.06 °C 0.06 °C 0.08 °C 0.11 °C 0.12 °C 0.14 °C 0.27 °C | Fluke 5522A calibrator |

| Parameter/Range | Frequency | CMC ^{2,4,10} (±) | Comments |
|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| AC Voltage – Generate ^{3,9} | | | |
| 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 | 0.23 % + 4 μV 0.16 % + 4 μV 0.13 % + 4 μV 0.18 % + 4 μV 0.23 % + 5 μV 0.37 % + 10 μV 0.46 % + 20 μV 0.62 % + 20 μV | Fluke 5720A calibrator |
| (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 | 0.040 % + 4 μV 0.019 % + 4 μV 0.017 % + 4 μV 0.031 % + 4 μV 0.069 % + 5 μV 0.14 % + 10 μV 0.18 % + 20 μV 0.34 % + 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 | 0.033 % + 12 μV 0.013 % + 7 μV 0.010 % + 7 μV 0.025 % + 7 μV 0.056 % + 17 μV 0.11 % + 20 μV 0.17 % + 25 μV 0.36 % + 45 μV | |

| Parameter/Range | Frequency | CMC ^{2, 4, 10} (\pm) | Comments |
|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|
| AC Voltage – Generate ³ (cont) | | | |
| 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 | 0.035 % + 40 μ V 0.013 % + 15 μ V 55 μ V/V + 8 μ V 100 μ V/V + 10 μ V 0.015 % + 30 μ V 0.059 % + 80 μ V 0.13 % + 200 μ V 0.27 % + 300 μ V | Fluke 5720A calibrator |
| (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 | 0.035 % + 400 μ V 0.013 % + 150 μ V 59 μ V/V + 50 μ V 100 μ V/V + 100 μ V 0.014 % + 200 μ V 0.046 % + 0.6 mV 0.13 % + 2 mV 0.26 % + 3.2 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 | 0.035 % + 4 mV 0.013 % + 1.5 mV 68 μ V/V + 0.6 mV 0.011 % + 1 mV 0.019 % + 2.5 mV | |
| (220 to 1100) V | (10 to 50) Hz 50 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz | 0.038 % + 16 mV 87 μ V/V + 3.5 mV 0.020 % + 6 mV 0.070 % + 11 mV | Fluke 5720A calibrator Fluke 5725A amplifier |
| (220 to 750) V | (30 to 50) kHz (50 to 100) kHz | 0.070 % + 11 mV 0.27 % + 45 mV | Fluke 5725A amplifier |
| AC Current – Generate ^{3, 9} | | | |
| Up to 220 μ A | (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz | 0.042 % + 16 nA 0.024 % + 10 nA 0.014 % + 8 nA 0.034 % + 12 nA 0.20 % + 65 nA | Fluke 5720A calibrator |

| Parameter/Range | Frequency | CMC ^{2, 6, 10} (\pm) | Comments |
|---------------------------------|-----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|------------------------|
| AC Current – Generate (cont) | | | |
| (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) | 0.039 % + 40 nA 0.024 % + 35 nA 0.020 % + 35 nA 0.032 % + 0.11 μ A 0.15 % + 0.65 μ A | Fluke 52120A amplifier |
| (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) | 0.048 % + 0.4 μ A 0.028 % + 0.35 μ A 0.022 % + 0.35 μ A 0.037 % + 0.55 μ A 0.20 % + 5 μ A | |
| (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) | 0.047 % + 4 μ A 0.028 % + 3.5 μ A 0.022 % + 2.5 μ A 0.034 % + 3.5 μ A 0.17 % + 10 μ A | |
| (0.22 to 2.2) A | 40 Hz to 1 kHz (1 to 5) kHz (5 to 10 kHz) | 0.044 % + 35 μ A 0.071 % + 80 μ A 1.0 % + 0.16 mA | |
| (2 to 20) A | (10 to 65) Hz (65 to 300) Hz 300 Hz to 1 kHz (1 to 3) kHz (3 to 6) kHz (6 to 10) kHz | 0.022 % + 9.4 mA 0.032 % + 9.4 mA 0.090 % + 9.4 mA 0.27 % + 31 mA 0.90 % + 62 mA 2.7 % + 94 mA | |
| (20 to 120) A | (10 to 65) Hz (65 to 300) Hz 300 Hz to 1 kHz (1 to 3) kHz (3 to 6) kHz | 0.031 % + 19 mA 0.038 % + 28 mA 0.092 % + 94 mA 0.27 % + 0.23 A 0.92 % + 0.42 A | |

| Parameter/Range | Frequency | CMC ^{2, 4, 10} (\pm) | Comments |
|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Current Clamps ³ – | | | |
| (10 to 16.5) A | (45 to 65) Hz (65 to 440) Hz | 0.29 % + 0.003 A 0.83 % + 0.003 A | Fluke 5522A + 50 turn coil |
| (16.5 to 150) A | (45 to 65) Hz (65 to 440) Hz | 0.32 % + 0.025 A 0.87 % + 0.027 A | |
| (150 to 1025) A | (45 to 65) Hz (65 to 440) Hz | 0.32 % + 0.09 A 1.5 % + 0.1 A | |
| (0 to 6000) A | (10 to 65) Hz (65 to 300) Hz | 0.82 % + 0.47 A 0.82 % + 0.84 A | Fluke 52120A + 25/50 turn coil |
| AC Voltage – Measure ^{3, 9} | | | |
| 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 | 0.20 % + 1.3 μ V 0.088 % + 1.3 μ V 0.053 % + 1.3 μ V 0.096 % + 2 μ V 0.14 % + 2.5 μ V 0.27 % + 4 μ V 0.28 % + 8 μ V 0.42 % + 8 μ V | Fluke 5790A, HP 3458A |
| (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 | 0.099 % + 1.3 μ V 0.044 % + 1.3 μ V 0.026 % + 1.3 μ V 0.047 % + 2 μ V 0.070 % + 2.5 μ V 0.14 % + 4 μ V 0.15 % + 8 μ V 0.27 % + 8 μ V | |
| (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 | 0.035 % + 1.3 μ V 0.023 % + 1.3 μ V 0.014 % + 1.3 μ V 0.025 % + 2 μ V 0.036 % + 2.5 μ V 0.094 % + 4 μ V 0.10 % + 8 μ V 0.20 % + 8 μ V | |

| Parameter/Range | Frequency | CMC ^{2, 4, 5, 6, 10} (±) | Comments |
|------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| AC Voltage – Measure ^{3, 9} (cont) | | | |
| (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 | 0.12 % + 1.5 μV 0.030 % + 1.5 μV 0.016 % + 1.5 μV 0.0086 % + 1.5 μV 0.016 % + 2 μV 0.031 % + 2.5 μV 0.061 % + 4 μV 0.082 % + 8 μV 0.14 % + 8 μV | Fluke 5790A, HP 3458A |
| (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 500 kHz to 1 MHz | 0.12 % + 1.5 μV 0.025 % + 1.5 μV 0.010 % + 1.5 μV 0.0052 % + 1.5 μV 0.0082 % + 2 μV 0.019 % + 2.5 μV 0.030 % + 4 μV 0.046 % + 8 μV 0.12 % + 8 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 500 kHz to 1 MHz | 0.12 % + 1.5 μV 0.025 % + 1.5 μV 0.0095 % + 1.5 μV 0.0041 % + 1.5 μV 0.0060 % + 2 μV 0.0094 % + 2.5 μV 0.021 % + 4 μV 0.036 % + 8 μV 0.11 % + 8 μV | |
| (0.7 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 (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz | 0.12 % 0.023 % 0.0080 % 0.0028 % 0.0054 % 0.0083 % 0.019 % 0.031 % 0.11 % | |

| Parameter/Equipment | Range | CMC ^{2, 4, 5, 6, 10} (±) | Comments |
|------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|--------------------------|
| AC Voltage – Measure ^{3, 9} (cont) | | | |
| (2.2 to 7) 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 (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz | 0.12 % 0.023 % 0.0081 % 0.0029 % 0.0056 % 0.0096 % 0.022 % 0.047 % 0.14 % | Fluke 5790A, HP 3458A |
| (7 to 22) 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 (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz | 0.12 % 0.023 % 0.0081 % 0.0033 % 0.0057 % 0.0094 % 0.022 % 0.047 % 0.14 % | |
| (22 to 70) 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 (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz | 0.12 % 0.023 % 0.0082 % 0.0039 % 0.0067 % 0.011 % 0.023 % 0.048 % 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 | 0.023 % 0.0082 % 0.0038 % 0.0081 % 0.011 % 0.024 % 0.058 % | |
| (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 | 0.023 % 0.012 % 0.0050 % 0.015 % 0.058 % | |

| Parameter/Range | Frequency | CMC ^{2, 4, 5, 6, 10} (±) | Comments |
|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|------------------------------------------------------|------------------------------------------------------------------------------|
| AC Voltage – Measure ^{3, 9} (cont) (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 | 0.023 % 0.012 % 0.0049 % 0.015 % 0.058 % | Fluke 5790A, HP 3458A |
| AC Voltage – Generate & Measure ³ (1 to 84) kV | 60 Hz | 0.68 % | Ross VD120 HV divider w/ Agilent 34401A meter & high voltage AC source |
| AC Current – Measure ^{3, 9} 10 µA to 20 A (20 to 50) A (50 to 100) A | 10 Hz to 10 kHz 10 Hz to 6 kHz 10 Hz to 6 kHz | 0.015 % 0.028 % 0.028 % | Fluke 5790A w/ Holt HCS-1 Ohm-Labs CS-50 shunt Ohm-Labs CS-100 shunt |
| AC Current – Generate & Measure ³ (100 to 6000) A | 60 Hz | 1.0 % | PEM LFR 30/300, Agilent 3458A, & current source |

| Parameter/Range | Frequency | CMC ^{2, 5, 6, 10} (±) | Comments |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| AC Power – Generate ^{3, 9} , PF=1 Up to 10.9 μW (10.9 to 109) μW (0.109 to 1.09) mW (1.09 to 10.9) mW (10.9 to 109) mW (0.109 to 1.09) W (1.09 to 10.9) W (10.9 to 37) W (37 to 337) W (0.337 to 1.12) kW (1.12 to 3.06) kW (3.06 to 11.2) kW (11.2 to 20.9) kW | (45 to 65) Hz | 0.17 % 0.13 % 0.06 % 0.056 % 0.055 % 0.055 % 0.055 % 0.058 % 0.063 % 0.076 % 0.081 % 0.09 % 0.17 % | Fluke 5522A calibrator |
| Phase Angle – Measure ^{3, 9} | 5 Hz to 2 kHz (2 to 5) kHz (5 to 20) kHz (20 to 50) kHz | 0.024° 0.038° 0.065° 0.073° | Clarke-Hess 6000A phase meter |

| Parameter/Equipment | Range | CMC ^{2, 4, 10} (±) | Comments |
|-------------------------------------------|-------------------------------------------------------------------------------------------------------|------------------------------------------------|------------------------|
| Phase Angle ^{3, 9} – 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 | 0.12° 0.29° 0.58° 2.9° 5.8° 12° | Fluke 5522A calibrator |

III. Mechanical

| Parameter/Equipment | Range | CMC ^{2,6,10} (±) | Comments |
|------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| Torque Wrenches ^{3,9} | 5 lbf-in to 2500 lbf-ft | 0.27 % | AKO torque system |
| Torque Multipliers ^{3,9} | Up to 5000 lbf-ft | 1.6 % | AWS torque multiplier system |
| Hydraulic, Pneumatic & Electric Torque Tools ^{3,9} | Up to 20 000 lbf-ft | 0.5 % | AKO torque system |
| Pressure ^{3,9} (Pneumatic) – Measuring Equipment, Gauge, Absolute, Differential | (0.2 to 25) psia (1.7 to 100) psia (2 to 1000) psia | 0.0013 % 0.0013 % 0.0028 % | Ruska 2465 |
| Effective Area Determination of Piston-Cylinder Unit (PCU) or Ball Nozzle Unit (BNU) | (100 to 2500) psi (6 to 12 000) psi (0.14 to 30) psi (10 to 300) psi (100 to 2500) psi | 0.0031 % 0.0037 % 0.0082 % 0.0063 % 0.0059 % | Ruska 2470 oil to gas (2400/2413) Deadweight tester effective area by cross float method |
| Pressure ^{3,9} (Hydraulic) – | | | |
| Effective Area Determination of Piston-Cylinder Unit (PCU) | (100 to 1500) psi (1000 to 15 000) psi | 0.0066 % 0.0071 % | Deadweight tester effective area by cross float method. |
| Calibration of High Accuracy Transfer Standards | (6 to 2400) psi (30 to 12 000) psi Up to 36 000 psi Up to 50 000 psi | 0.0025 % 0.0035 % 0.029 % 0.010 % | Ruska 2400HL Additel pressure gauge Budenberg 5360 |

| Parameter/Equipment | Range | CMC ² (±) | Comments |
|---------------------|-------|----------------------|----------|
|---------------------|-------|----------------------|----------|

| | | | |
|-------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|------------------------------------------------|
| Mass – | 1 mg to 10 g (10 to 50) g (50 to 200) g (200 to 1000) g (1000 to 5000) g (5000 to 12 000) g | 0.000 027 g 0.000 040 g 0.000 15 g 0.000 80 g 0.006 g 0.06 g | Single substitution |
| | 1 mg to 81 g (81 to 210) g (210 to 1100) g (1100 to 2000) g (2000 to 6000) g (6000 to 12 000) g (12 000 to 68 040) g | 0.0004 g 0.000 51 g 0.0046 g 0.045 g 0.086 g 0.83 g 48 g | Directly read from analytical or digital scale |
| Balances & Scales ^{3,9} | 1 mg to 81 g (81 to 210) g (210 to 1100) g (1100 to 2000) g (2000 to 6000) g (6000 to 12 000) g | 0.000 042 g 0.000 22 g 0.0014 g 0.0015 g 0.0034 g 0.0063 g | Class 1 mass |
| Indirect Hardness Verification ^{3,9} – | | | |
| Rockwell | | | |
| Rockwell A Scale | 33 HRA 53 HRA 83 HRA | 0.68 HRA 0.68 HRA 0.68 HRA | Standardized hardness test blocks |
| Rockwell B Scale | 35 HRB 55 HRB 85 HRB | 0.69 HRB 0.69 HRB 0.69 HRB | |
| Rockwell C Scale | 25 HRC 45 HRC 63 HRC | 0.71 HRC 0.71 HRC 0.71 HRC | |

IV. Thermodynamics

| Parameter/Equipment | Range | CMC ^{2,10} (±) | Comments |
|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Temperature – Measure ^{3,9} | (-197 to -38.8) °C (-38.8 to 0.01) °C 0.01 °C (0.01 to 29.7) °C (29.7 to 156.5) °C (156.5 to 231.9) °C (231.9 to 419.5) °C (491.5 to 660) °C (660 to 900) °C (900 to 1100) °C (1100 to 1450) °C | 0.012 °C 0.0024 °C 0.0016 °C 0.0028 °C 0.0040 °C 0.0054 °C 0.0070 °C 0.0095 °C 0.97 °C 1.4 °C 3.5 °C | Hart 5699 SPRT, 1595A Super-Thermometer Hart Scientific 5650 with type S thermocouple & Hart Scientific 1529A |
| Temperature – Generate ^{3,9} | (-40 to 0.01) °C 0.01 °C (0.01 to 30) °C (30 to 60) °C (40 to 160) °C (160 to 232) °C (232 to 420) °C (420 to 660) °C (660 to 900) °C (900 to 1200) °C | 0.0098 °C 0.0017 °C 0.0099 °C 0.014 °C 0.011 °C 0.027 °C 0.039 °C 0.075 °C 1.4 °C 2.0 °C | Hart Scientific 5699 SPRT, 1595A Super-Thermometer with the following source: Fluke 7341 bath Fluke 5901B-G Mini TPW cell Fluke 7341 bath Fluke 6331 bath Fluke 9173 metrology well Hart Scientific 5650 with type S thermocouple, Hart Scientific 1529, & Fluke 9150 furnace |
| Relative Humidity – Measure ^{3,9} | 11 % RH 33 % RH 56 % RH 75 % RH 85 % RH | 0.66 % RH 0.77 % RH 0.73 % RH 0.96 % RH 1.2 % RH | Vaisala MI70/HMP75 & salt baths |

V. Time & Frequency

| Parameter/Equipment | Range | CMC ^{2,10} (\pm) | Comments |
|------------------------------------------------------|-------------------|-------------------------------|----------------------------------|
| Frequency – Measure ^{3,9} | 0.1 Hz to 2.7 GHz | 1.8 parts in 10 ⁸ | Fluke PM6681 |
| Time Interval – Timers & Stop Watches ^{3,9} | | | NIST SP 960-12 |
| Time Base ⁸ | (0 to 24) hours | 0.06 s/day | Helmut Klein 4500 Timometer |
| Totalize Method | (0 to 24) hours | 0.12 s | Fluke PM6681, function generator |

¹ This laboratory offers commercial calibration service 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 Generate. 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 This laboratory performs field calibration activities for these parameters. 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. Field environmental conditions are limited to 15 °C to 30 °C and <80% relative humidity to 30 °C.

⁴ Fluke 5700A and 5500A CMCs are based upon the temperature the standard was calibrated ($t_{cal} \pm 5$ °C) and assuming the instrument is zeroed at least every seven days or when the ambient temperature changes more than 5 °C. For Resistance, a zero calibration is performed at least every 12 hours within ± 1 °C of use. For AC Current, best uncertainties are determined with the LCOMP off. CMCs are also based upon 1-year floor specifications. 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.

⁵ Agilent 3458A CMCs are based upon the temperature the standard was calibrated ($t_{cal} \pm 5$ °C) and an auto calibration (ACAL) was performed within the previous 24 hours (± 1 °C of ambient temperature.) CMCs are also based upon 1-year floor specifications. CMCs are expressed as either a specific value that covers the full range or as a combination of the fraction/percentage of the reading/output plus a range specification.

⁶ In the statement of CMC, percentages are percentages of reading, unless otherwise indicated.

- ⁷ In the statement of CMC, L is the numerical value of the nominal length in inches.
- ⁸ Applicable when the internal time base (oscillator) of the device under test is/can be measured directly by the frequency counter.
- ⁹ This laboratory may perform field calibration activities for these parameters with their Mobile Laboratory.
- ¹⁰ 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.
- ¹¹ This scope meets A2LA's *P112 Flexible Scope Policy*.



Accredited Laboratory

A2LA has accredited

JM TEST SYSTEMS, INC.

Baton Rouge, LA

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 the requirements of ANSI/NCSL Z540-1-1994 and the requirements of ANSI/NCSL Z540.3-2006 and 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 16th day of December 2022.

A blue ink signature of the Vice President of Accreditation Services.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 1995.01
Valid to November 30, 2024

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