



CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

CalTek Electronics Joint Stock Company
03rd Floor Ha Nam Plaza, West Quarter, Vinh Phu Ward
Thuan An Town, Binh Duong Province, Vietnam
(and satellite location as shown on the scope)

Fulfills the requirements of

ISO/IEC 17025:2017

In the field of

CALIBRATION

This certificate is valid only when accompanied by a current scope of accreditation document.
The current scope of accreditation can be verified at www.anab.org.

A handwritten signature in black ink, appearing to be 'J. Stine', is positioned above a horizontal line.

Jason Stine, Vice President

Expiry Date: 23 June 2025
Certificate Number: AC-2478



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.
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).

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

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CALIBRATION

Valid to: **June 23, 2025**

Certificate Number: **AC-2478**

Acoustics and Vibration

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--------------------------------|-------------------------------|---|--|
| Sound Level Meter ¹ | 1 kHz | | Soundtek ST-120 Sound Level Calibrator |
| | 94 dB 114 dB | 0.59 dB 0.59 dB | |
| Vibration ¹ | | | PCB Calibration Exciter |
| Acceleration | 9.8 m/s ² , 159 Hz | 4.2 % of reading | |
| Velocity | 9.8 mm/s, 159 Hz | 4.2 % of reading | |
| Displacement | 9.9 μm | 4.2 % of reading | |

Chemical Quantities

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|-----------------------------------|----------------------------|---|--|
| pH Measure ⁵ | 4 pH | 0.019 pH | Standard pH solutions |
| | 7 pH | 0.022 pH | |
| | 10 pH | 0.023 pH | |
| Conductivity Measure ⁵ | 2 μS/cm | 0.24 μS/cm | Standard Conductivity Solutions |
| | 5 μS/cm | 0.19 μS/cm | |
| | 84 μS/cm | 1.5 μS/cm | |
| | 1413 μS/cm | 24 μS/cm | |
| | 12.88 mS/cm 111.8 mS/cm | 0.23 mS/cm 1.9 mS/cm | |
| Refractometers | (0 to ~53) %Brix | 0.27 %Brix | Comparison to Reference Refractometer, Sucrose Solutions |

Chemical Quantities

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|-----------------------------------|---|--|--|
| Salinity Refractometer | (0 to ~10) %Salinity | 4.7 % of reading + 0.12 %Salinity | Comparison to Reference Salinity Meter, Salinity Solutions |
| Viscosity Meter ⁵ | (5 to 5 000) cP (5 000 to 10 000) cP | 0.4 % of reading + 0.5 cP 1.8 % of reading + 8.2 cP | Comparison to Reference Viscosity Meter, Cannon Standard Viscosity Solutions |
| Gas Detectors ⁵ | | | |
| H ₂ S | 0.001 5 % Concentration | 0.000 052 % Concentration | Standard Gases |
| CO | 0.005 % Concentration | 0.000 19 % Concentration | |
| CH ₄ | 50 % Concentration LEL | 1.7 % Concentration LEL | |
| O ₂ | 18 % Concentration of N ₂ | 0.62 % Concentration of N ₂ | |
| Gas Detectors – TVOC ⁵ | | | |
| I-C ₄ H ₈ | 0.001 % Concentration 0.01 % Concentration | 0.000 039 % Concentration 0.000 36 % Concentration | Standard Gases, Reference RAE Mini RAE3000 |
| Alcohol Meter ⁵ | (0 to 100) %Volume | 0.82 %Volume | Comparison to Reference Alcohol Meter, Alcohol Solutions |
| TDS Meter ⁵ | 100 mg/l 1 000 mg/l | 2.7 mg/l 26 mg/l | Standard TDS Solutions |
| Chlorine Meter ⁵ | 1 mg/l | 0.014 mg/l | Standard Chlorine Solution |
| Turbidity Meter ⁵ | 100 NTU 1 000 NTU | 1.3 NTU 11 NTU | Standard Turbidity Calibration Solutions |

Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|-----------------------------------|---|--|---|
| DC Voltage – Measure ¹ | Up to 100 mV 100 mV to 1 V (1 to 10) V (1V to 100) V (100 to 1 000) V | 8.7 μV/V + 1.4 μV 5.7 μV/V + 5.4 μV 9 μV/V + 5.9 μV 10 μV/V + 6.8 μV 11.4 μV/V + 75 μV | Agilent 3458A Opt 002 8.5 Digit Multimeter |
| DC Current – Measure ¹ | Up to 100 μA 100 μA to 1 mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A | 0.2 nA/A + 0.37 μA 0.1 mA/A + 2.9 nA 0.1 mA/A + 22 nA 0.1 mA/A + 0.36 μA 0.16 mA/A + 10 μA | Agilent 3458A Opt 002 8.5 Digit Multimeter |

Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|---|---|--|
| DC Current – Measure ¹ | (1 to 3) A (3 to 10) A (10 to 100) A | 1.3 mA/A + 0.82 mA 1.4 mA/A + 1.3 mA 6.2 mA/A + 0.11 A | Agilent 34401A 6.5 Digit Multimeter, Keysight 34461A 6.5 Digit Multimeter, Current Shunt |
| | (100 to 400) A | 22 mA/A + 0.9 A | Kyoritsu Kewsnap 2009R Clamp Meter |
| DC Voltage – Source ¹ | Up to 329.999 9 mV (0.33 to 3.299 99) V (3.3 to 32.999 99) V (33 to 329.999 9) V (330 to 1 020) V | 70 nV/mV + 3.5 μV 58 nV/V + 6.2 μV 58 nV/V + 67 μV 65 μV/V + 0.59 mV 64 μV/V + 2.1 mV | Fluke 5502A Multiproduct Calibrator |
| DC Current – Source ¹ | Up to 329.999 μA (0.33 to 3.299 99) mA (3.3 to 32.999 9) mA (33 to 329.999) mA (0.33 to 1.099 99) mA (1.1 to 2.999 99) A (3 to 10.999 9) A (11 to 20.5) A | 0.18 nA/μA + 24 nA 0.12 μA/mA + 63 nA 0.15 μA/mA + 0.44 μA 0.14 μA/mA + 4.2 μA 0.47 mA/A + 66 μA 0.43 μA/A + 0.1 mA 0.7 mA/A + 0.75 mA 1.1 mA/A + 1.2 mA | Fluke 5502A Multiproduct Calibrator |
| DC Current Clamp-on Meters ¹ | (20.5 to 1 000) A | 5.7 mA/A + 48 mA | Fluke 5502A Multiproduct Calibrator, Current Coil |
| AC Voltage – Measure ¹ | Up to 100 mV 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (0.1 to 1) V 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (1 to 10) V 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz | 0.21 μV/mV + 1.7 μV 0.19 μV/mV + 2.5 μV 0.46 μV/mV + 2 μV 1.4 μV/mV + 1.6 μV 0.12 mV/V + 21 μV 0.19 mV/V + 22 μV 0.36 mV/V + 23 μV 0.97 mV/V + 23 μV 0.12 mV/V + 0.21 mV 0.19 mV/V + 0.22 mV 0.36 mV/V + 0.23 mV 0.97 mV/V + 0.22 mV | Agilent 3458A Opt 002 8.5 Digit Multimeter |



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Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|-----------------------------------|----------------------|---|---|
| AC Voltage – Measure ¹ | (1 to 10) V | | Agilent 3458A Opt 002 8.5 Digit Multimeter |
| | 40 Hz to 1 kHz | 0.13 mV/V + 0.21 mV | |
| | (1 to 20) kHz | 0.19 mV/V + 0.22 mV | |
| | (20 to 50) kHz | 0.36 mV/V + 0.23 mV | |
| | (50 to 100) kHz | 0.97 mV/V + 0.22 mV | |
| | (10 to 100) V | | |
| | 40 Hz to 1 kHz | 0.25 mV/V + 2.2 mV | |
| | (1 to 20) kHz | 0.25 mV/V + 2.2 mV | |
| | (20 to 50) kHz | 0.45 mV/V + 2.2 mV | |
| | (50 to 100) kHz | 1.5 mV/V + 2.2 mV | |
| AC Voltage – Source ¹ | (100 to 750) V | | Fluke 5502A Multiproduct Calibrator |
| | 40 Hz to 1 kHz | 0.47 mV/V + 18 mV | |
| | (1 to 32.999) mV | | |
| | (10 to 45) Hz | 1.7 μV/mV + 23 μV | |
| | 45 Hz to 10 kHz | 1.2 μV/mV + 23 μV | |
| | (10 to 20) kHz | 1.7 μV/mV + 23 μV | |
| | (20 to 50) kHz | 2.3 μV/mV + 23 μV | |
| | (50 to 100) kHz | 4 μV/mV + 38 μV | |
| | (100 to 500) kHz | 12 μV/mV + 69 μV | |
| | (33 to 329.999) mV | | |
| | (10 to 45) Hz | 0.58 μV/mV + 23 μV | |
| | 45 Hz to 10 kHz | 0.35 μV/mV + 19 μV | |
| | (10 to 20) kHz | 0.89 μV/mV + 22 μV | |
| | (20 to 50) kHz | 1.2 μV/mV + 47 μV | |
| | (50 to 100) kHz | 2.7 μV/mV + 0.2 mV | |
| | (100 to 500) kHz | 5.8 μV/mV + 0.38 mV | |
| | (0.33 to 3.299 99) V | | |
| | (10 to 45) Hz | 0.58 mV/V + 71 μV | |
| | 45 Hz to 10 kHz | 0.35 mV/V + 71 μV | |
| | (10 to 20) kHz | 0.81 mV/V + 72 μV | |
| | (20 to 50) kHz | 1.2 mV/V + 71 μV | |
| | (50 to 100) kHz | 2.7 mV/V + 0.23 mV | |
| | (100 to 500) kHz | 5.8 mV/V + 1 mV | |
| | (3.3 to 32.999 9) V | | |
| | (10 to 45) Hz | 0.58 mV/V + 0.98 mV | |
| | 45 Hz to 10 kHz | 0.35 mV/V + 0.77 mV | |
| | (10 to 20) kHz | 0.8 mV/V + 0.85 mV | |
| | (20 to 50) kHz | 1.2 mV/V + 0.82 mV | |
| (50 to 100) kHz | 2.7 mV/V + 2.3 mV | | |



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Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|----------------------------------|---|---|--|
| AC Voltage – Source ¹ | (33 to 329.999) V (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (330 to 1 020) V 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz | 0.58 mV/V + 4.1 mV 0.92 mV/V + 11 mV 1 mV/V + 11 mV 1.4 mV/V + 11 mV 2.8 mV/V + 98 mV 0.58 mV/V + 30 mV 0.92 mV/V + 26 mV 1 mV/V + 25 mV | Fluke 5502A Multiproduct Calibrator |
| AC Current – Source ¹ | (29 to 329.99) μ A (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz (0.33 to 3.299 99) mA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz (3.3 to 32.99 99) mA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz (33 to 329.999) mA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz | 2.4 nA/ μ A + 0.12 μ A 1.8 nA/ μ A + 0.12 μ A 1.4 nA/ μ A + 0.16 μ A 3.4 nA/ μ A + 0.2 μ A 9.2 nA/ μ A + 0.24 μ A 19 nA/ μ A + 0.45 μ A 5 μ A/mA + 90 nA 1.6 μ A/mA + 0.16 μ A 1.1 μ A/mA + 0.57 μ A 2.3 μ A/mA + 0.5 μ A 5.8 μ A/mA + 0.47 μ A 12 μ A/mA + 0.41 μ A 4.8 μ A/mA + 1.1 μ A 1.2 μ A/mA + 2.2 μ A 0.52 μ A/mA + 6.8 μ A 0.92 μ A/mA + 6.3 μ A 2.4 μ A/mA + 5.6 μ A 6 μ A/mA + 13 μ A 2.2 μ A/mA + 23 μ A 1.1 μ A/mA + 23 μ A 0.34 μ A/mA + 74 μ A 1.1 μ A/mA + 87 μ A 2.3 μ A/mA + 0.13 mA 4.3 μ A/mA + 0.32 mA | Fluke 5502A Multiproduct Calibrator |

Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|----------------------------|---|---|
| AC Current – Source ¹ | (0.33 to 1.099 99) A | 2.2 mA/A + 0.11 mA | Fluke 5502A Multiproduct Calibrator |
| | (10 to 45) Hz | 0.56 mA/A + 0.16 mA | |
| | 45 Hz to 1 kHz | 6.9 mA/A + 1.2 mA | |
| | (1 to 5) kHz | 29 mA/A + 5.8 mA | |
| | (5 to 10) kHz | | |
| | (1 to 2.999 99) A | 2 mA/A + 0.11 mA | |
| | (10 to 45) Hz | 0.8 mA/A + 0.1 mA | |
| | 45 Hz to 1 kHz | 6.9 mA/A + 1.2 mA | |
| | (1 to 5) kHz | 29 mA/A + 5.8 mA | |
| | (5 to 10) kHz | | |
| | (3 to 10.999 9) A | 0.78 mA/A + 2.7 mA | |
| | (10 to 45) Hz | 1.4 mA/A + 2.1 mA | |
| 45 Hz to 1 kHz | 35 mA/A + 2.3 mA | | |
| (1 to 5) kHz | | | |
| (11 to 20.5) A | 1.6 mA/A + 5.2 mA | | |
| (45 to 100) Hz | 1.9 mA/A + 5.3 mA | | |
| 100 Hz to 1 kHz | 34.7 mA/A + 5.8 mA | | |
| (1 to 5) kHz | | | |
| AC Current Clamp-on Meters ¹ | (20.5 to 1 000) A 50 Hz | 5.7 mA/A + 85 mA | Fluke 5502A Multiproduct Calibrator, Current Coil |
| AC Current – Measure ¹ | Up to 100 µA | 0.82 nA/µA + 34 nA | Agilent 3458A Opt 002 8.5 Digit Multimeter |
| | (45 to 100) Hz | 0.81 nA/µA + 34 nA | |
| | 100 Hz to 5 kHz | | |
| | (0.1 to 1) mA | 0.88 µA/mA + 0.22 µA | |
| | (45 to 100) Hz | 0.55 µA/mA + 0.22 µA | |
| | 100 Hz to 5 kHz | | |
| | (1 to 10) mA | 0.83 µA/mA + 2.3 µA | |
| | (45 to 100) Hz | 0.54 µA/mA + 2.2 µA | |
| | 100 Hz to 5 kHz | | |
| | (10 to 100) mA | 0.83 µA/mA + 23 µA | |
| | (45 to 100) Hz | 0.55 µA/mA + 22 µA | |
| | 100 Hz to 5 kHz | | |
| (0.1 to 1) A | 1.1 mA/A + 0.22 mA | | |
| (45 to 100) Hz | 1.3 mA/A + 0.22 mA | | |
| 100 Hz to 5 kHz | | | |
| (1 to 3) A | 1.5 mA/A + 3.4 mA | Agilent 34401A 6.5 Digit Multimeter | |
| (1 to 50) Hz | 2.1 mA/A + 5.2 mA | Keysight 34461A 6.5 Digit Multimeter | |
| 50 Hz to 1 kHz | | | |
| (3 to 400) A | 17.4 mA/A + 0.61 A | Kyoritsu Kewsnap 2009R Current Clamp Meter | |
| 50 Hz | | | |

Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment | |
|---|---|--|--|---|
| Oscilloscopes ¹ | | | | |
| Amplitude – DC Signal into 50 Ω Load into 1 MΩ Load | Up to 2.2 V Up to 33 V | 5 mV/V + 2 mV 2.7 mV/V + 7.8 mV | Fluke 5520A/SC300 Multiproduct Calibrator with 300 MHz Scope Option | |
| Amplitude – Square Wave into 50 Ω Load into 1 MΩ Load | 1.8 mVp-p to 2.2 Vp-p 10 Hz to 10 kHz 1.8 mVp-p to 105 Vp-p 10 Hz to 10 kHz | 2.6 mV/V + 2 mV 2.9 mV/V + 0.32 mV | | |
| Amplitude – Leveled Sine Wave into 50 Ω Load | 5 mVp-p to 5.5 Vp-p 50 kHz 50 kHz to 100 MHz (100 to 300) MHz | 26 mV/V + 0.81 V 45 mV/V + 1.1 mV 51 mV/V + 1.1 mV | | |
| Time Marker | (2 to 10) ns 20 ns to 1 μs (2 to 50) μs 100 μs to 5 s | 0.56 ps 13 ps/μs + 30 ps 16 ps/μs + 0.1 ns 0.24 ms/s + 4.1 μs | | |
| Wave Generator (Square, Sine, Triangle Wave) into 50 Ω Load into 1 MΩ Load | 1.8 mVp-p to 2.2 Vp-p 10 Hz to 100 kHz 1.8 mVp-p to 55 Vp-p 10 Hz to 100 kHz | 39 mV/V + 0.22 mV 39 mV/V + 0.2 mV | | |
| DC Resistance – Source ¹ (Variable Artifact) (LCR Meters) | (10 to 100) mΩ (0.1 to 1) Ω (1 to 10) Ω (10 to 100) Ω (100 to 1 000) Ω (1 to 10) kΩ (10 to 40) kΩ | 0.1 mΩ/Ω + 2 mΩ 0.1 mΩ/Ω + 2 mΩ 0.12 mΩ/Ω + 2.3 mΩ 0.1 mΩ/Ω + 3.7 nΩ 0.12 mΩ/Ω + 2.7 mΩ 30 mΩ/kΩ + 5.8 Ω 61 mΩ/kΩ + 57 Ω | | General Radio 1433-M Decade Resistor |
| Capacitance – Source ¹ (Variable Artifact) (LCR Meters – 1 kHz) | (10 to 100) pF (100 to 1 000) pF (1 to 10) nF (10 to 100) nF (0.1 to 1) μF | 6.5 fF/pF + 5.7 pF 5.8 fF/pF + 5.8 pF 5.7 fF/pF + 7.4 pF 5.8 nF/μF + 57 pF 5.3 nF/μF + 0.57 nF | | General Radio 1412-BC Decade Capacitor |

Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---|--|---|---|
| Inductance – Source ¹ (Variable Artifact) (LCR Meters - 1 kHz) | (1 to 10) mH (10 to 100) mH (0.1 to 1) H (1 to 10) H | 23 μ H/mH + 17 nH 11.4 μ H/mH + 1.5 μ H 6.9 μ H/mH + 6.6 μ H 7 μ H/H + 44 μ H | General Radio 1490-D Decade Inductor |
| Hipot Testers, Spark Testers, Surge Testers, Impulse Winding Testers ¹ AC Cut-off Current | 50/60 Hz (29 to 500) μ A (500 to 5 000) μ A (5 to 50) mA (50 to 100) mA | 7 nA/ μ A + 0.26 μ A 7 nA/ μ A + 0.62 μ A 7 μ A/mA + 23 μ A 7 μ A/mA + 64 μ A | Resistance Box, Fluke 287 Digital Multimeter |
| DC Cut-off Current | Up to 500 μ A (500 to 5 000) μ A (5 to 50) mA (50 to 100) mA | 0.9 nA/ μ A + 0.23 μ A 0.89 nA/ μ A + 0.26 μ A 0.6 μ A/mA + 12 μ A 1.7 μ A/mA + 27 μ A | |
| AC High Voltage | 50 Hz Up to 4.24 kV (4 to 25) kV | 15 V/kV + 4 V 61 V/kV + 23 V | Fluke 287 DMM, High Voltage Probe |
| Ground Bond Tester ¹ | Up to 500 m Ω | 9.5 m Ω | General Resistance RDS41-A Decade Resistor |
| Withstanding/Insulation Testers ¹ | | | |
| DC Voltage | Up to 6 kV (6 to 35) kV | 13 V/kV 23 V/kV + 18 V | |
| DC Current | Up to 2 mA (2 to 20) mA | 23 μ A 0.23 mA | Time Electronics 5069 Insulation Tester Calibrator, Fluke 287 DMM, High Voltage Probe |
| Resistance | (0.1 to 5) M Ω (10 to 100) M Ω (10 to 1 000) M Ω (1 to 10) G Ω (10 to 100) G Ω | 11 k Ω /M Ω + 0.9 k Ω 12 k Ω /M Ω + 0.85 k Ω 12 k Ω /M Ω + 3.5 k Ω 12 M Ω /G Ω + 16 M Ω 57 M Ω /G Ω + 4 M Ω | |
| Resistance – Source ¹ (Simulated) | Up to 10.999 Ω (11 to 32.999) Ω (33 to 109.999) Ω (110 to 329.999) Ω (0.33 to 1.099 99) k Ω (1.1 to 3.299 99) k Ω | 0.13 m Ω / Ω + 1.3 m Ω 0.11 m Ω / Ω + 3.2 m Ω 0.1 m Ω / Ω + 2.6 m Ω 0.1 m Ω / Ω + 2.4 m Ω 0.1 Ω /k Ω + 5.6 m Ω 0.1 Ω /k Ω + 24 m Ω | Fluke 5502A Multiproduct Calibrator |



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Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---|---|---|---|
| Resistance – Source ¹ (Simulated) | (3.3 to 11) kΩ (11 to 32.999 9) kΩ (33 to 109.999) kΩ (110 to 329.999) kΩ 330 kΩ to 1.099 99 MΩ (1.1 to 3.299 99) MΩ (3.3 to 10.999 9) MΩ (11 to 32.999 9) MΩ (33 to 109.999) MΩ (110 to 329.999) MΩ (330 to 1 100) MΩ | 0.1 Ω/kΩ + 60 mΩ 0.1 Ω/kΩ + 0.24 Ω 0.14 Ω/kΩ + 0.14 Ω 0.15 Ω/kΩ + 2.3 Ω 0.2 kΩ/MΩ + 4.4 Ω 0.2 kΩ/MΩ + 32 Ω 0.7 kΩ/MΩ + 63 Ω 1.3 kΩ/MΩ + 2.7 kΩ 5.8 kΩ/MΩ + 3.5 kΩ 7.6 kΩ/MΩ + 9.1 kΩ 18 kΩ/MΩ + 0.56 MΩ | Fluke 5502A Multiproduct Calibrator |
| Resistance – Measure ¹ | Up to 10 Ω (10 to 100) Ω (0.1 to 1) kΩ (1 to 10) kΩ (10 to 100) kΩ (0.1 to 1) MΩ (1 to 10) MΩ (10 to 100) MΩ | 18 μΩ/Ω + 85 μΩ 15 μΩ/Ω + 0.57 mΩ 13 mΩ/kΩ + 0.8 mΩ 13 mΩ/kΩ + 6 mΩ 13 mΩ/kΩ + 72 mΩ 23 Ω/MΩ + 2.3 Ω 65 Ω/MΩ + 0.11 kΩ 0.58 kΩ/MΩ + 1.1 kΩ | Agilent 3458A Opt 002 8.5 Digit Multimeter |
| Capacitance (Simulated) ¹ 10 Hz to 10 kHz 10 Hz to 10 kHz 10 Hz to 3 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz (10 to 50) Hz (10 to 20) Hz DC to 6 Hz DC to 2 Hz DC to 0.6 Hz DC to 0.2 Hz | (220 to 399.9) pF 400 pF to 1.099 9 nF (1.1 to 3.299 9) nF (3.3 to 10.999) nF (11 to 32.999) nF (33 to 109.99) nF (110 to 329.99) nF (0.33 to 1.099 9) μF (1.1 to 3.299 9) μF (3.3 to 10.999) μF (11 to 32.999) μF (33 to 109.99) μF (110 to 329.99) μF (0.33 to 1.099 9) mF (1.1 to 3.299 9) mF (3.3 to 10.999) mF (11 to 32.999) mF (33 to 110) mF | 5.8 fF/pF + 12 pF 5.8 pF/nF + 12 pF 5.8 pF/nF + 12 pF 2.9 pF/nF + 12 pF 2.9 pF/nF + 12 pF 2.9 pF/nF + 0.12 nF 2.9 pF/nF + 0.34 nF 2.9 nF/μF + 1.2 nF 2.9 nF/μF + 3.4 nF 3 nF/μF + 12 nF 2.9 nF/μF + 35 nF 6.7 nF/μF + 67 nF 5.2 nF/μF + 0.36 μF 5.2 μF/mF + 1.2 μF 5.2 μF/mF + 3.5 μF 5.2 μF/mF + 12 μF 8.4 μF/mF + 41 μF 13 μF/mF + 0.12 mF | Fluke 5502A Multiproduct Calibrator |



ANSI National Accreditation Board

Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|-------------------------|---|--|
| Electrical Simulation of Thermocouple Indicating Devices – Source/Measure ¹ | Type B | | Fluke 5502A Multiproduct Calibrator |
| | (600 to 800) °C | 0.52 °C | |
| | (800 to 1 000) °C | 0.41 °C | |
| | (1 000 to 1 550) °C | 0.35 °C | |
| | (1 550 to 1 820) °C | 0.4 °C | |
| | Type E | | |
| | (-250 to -100) °C | 0.59 °C | |
| | (-100 to -25) °C | 0.2 °C | |
| | (-25 to 350) °C | 0.2 °C | |
| | (350 to 650) °C | 0.21 °C | |
| | (650 to 1 000) °C | 0.35 °C | |
| | Type J | | |
| | (-210 to -100) °C | 0.33 °C | |
| | (-100 to -30) °C | 0.25 °C | |
| | (-30 to 150) °C | 0.25 °C | |
| | (150 to 760) °C | 0.27 °C | |
| | (760 to 1 200) °C | 0.31 °C | |
| | Type K | | |
| | (-200 to -100) °C | 0.4 °C | |
| | (-100 to -25) °C | 0.24 °C | |
| | (-25 to 120) °C | 0.24 °C | |
| (120 to 1 000) °C | 0.32 °C | | |
| (1 000 to 1 372) °C | 0.49 °C | | |
| Type R | | | |
| (0 to 250) °C | 0.67 °C | | |
| (250 to 400) °C | 0.44 °C | | |
| (400 to 1 000) °C | 0.41 °C | | |
| (1 000 to 1 767) °C | 0.56 °C | | |
| Type T | | | |
| (-250 to -150) °C | 0.74 °C | | |
| (-150 to 0) °C | 0.31 °C | | |
| (0 to 120) °C | 0.21 °C | | |
| (120 to 400) °C | 0.19 °C | | |
| Tesla Meter, Gauss Meter | 3 mT 50 mT 500 mT | 0.24 mT 2.4 mT 13 mT | Reference Magnetic Field Block |

Electrical – RF/Microwave

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---|---|---|--|
| RF Power – Source ¹ 100 kHz to 50 MHz | (-70 to 0) dBm (0 to 13) dBm | 1.3 dB 1.3 dB | Hewlett Packard 8648C Signal Generator |
| 50 MHz to 2.5 GHz | (-70 to -25.9) dBm (-25.9 to 0) dBm (0 to 13) dBm | 1.3 dB 1.2 dB 1.2 dB | |
| (2.5 to 3.2) GHz | (-70 to -25.9) dBm (-25.9 to 0) dBm (0 to 13) dBm | 1.8 dB 1.8 dB 1.8 dB | |
| RF Power – Measure ¹ 10 MHz to 18 GHz | (-60 to -20) dBm (-20 to 20) dBm | 1.3 dB 1.2 dB | |

Length – Dimensional Metrology

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|-------------------------------------|---|---|
| Gauge Blocks, Length Bar, Micrometer Standard Bar, Master Ball | (0.01 to 100) mm (100 to 500) mm | 2.5 nm/mm + 0.2 μm 14 nm/mm + 0.1 μm | LMM 600 Universal Length Measuring Machine, Grade 0 Gauge Blocks |
| Calipers ¹ | Up to 600 mm | 3.2 nm/mm + 8.5 μm | Gauge Blocks |
| Micrometers ¹ | Up to 25.4 mm (25.4 to 500) mm | 5.6 nm/mm + 0.2 μm 12 nm/mm + 1.2 μm | Optical Flat, Gauge Blocks |
| Height Gauges ¹ | Up to 600 mm | 14 nm/mm + 0.11 μm | Gauge Blocks |
| Depth Gauges ¹ | Up to 500 mm | 14 nm/mm + 5.6 μm | Gauge Blocks |
| Cylindrical Ring Gauges | (3 to 100) mm | 9.5 nm/mm + 0.55 μm | LMM 600 Universal Length Measuring Machine |
| Bore Gauges | Up to 100 mm | 11 nm/mm + 0.3 μm | LMM 600 Universal Length Measuring Machine |
| Thickness Gauges – Measure Mode ¹ | Up to 100 mm | 5.8 nm/mm + 1.2 μm | Gauge Blocks |

Length – Dimensional Metrology

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|--|---|--|
| Thread Ring Gauges | (3 to 100) mm | 9.5 nm/mm + 0.55 μ m | LMM 600 Universal Length Measuring Machine |
| Thread Plug Gauges | (1 to 100) mm | 5.3 nm/mm + 1.8 μ m | LMM 600 Universal Length Measuring Machine |
| Coordinate Measuring Machines ¹ (CMM) | X-axis: Up to 600 mm Y-axis: Up to 600 mm Z-axis: Up to 500 mm | 12 nm/mm + 0.15 μ m 12 nm/mm + 0.12 μ m 12 nm/mm + 0.16 μ m | Grade 0 Gauge Blocks, Grade 0 Long Gauge Blocks |
| Measuring Microscopes, Vision Systems ¹ | X-Y Axis: Up to 300 mm | 6.1 nm/mm + 1.9 μ m | Grade 0 Gauge Blocks, Grade 0 Long Gauge Blocks |
| Profile Projectors ¹ | X-Y Axis: Up to 300 mm | 6.2 nm/mm + 1.9 μ m | Grade 0 Gauge Blocks, Grade 0 Long Gauge Blocks |
| Contour Measuring Machine | X-axis: Up to 100 mm Z-axis: Up to 25.4 mm | 6.6 nm/mm + 1 μ m 0.95 μ m | Gauge Block Set, Master Ball |
| Laser Micrometers | Up to 100 mm | 0.6 μ m | Pin Gauge Set |
| Coating Thickness Meters ¹ | (25 to 1 500) μ m | 2.8 μ m | Coating Thickness Standards |
| Thickness Gauges, Feeler Gauges, Thickness Films | Up to 5 mm | 2.5 nm/mm + 0.29 μ m | LMM 600 Universal Length Measuring Machine |
| Dial Indicators, Dial Indicators ¹ | Up to 100 mm | 11 nm/mm + 0.21 μ m | Gauge Blocks |
| Dial Test Indicators ¹ | Up to 1 mm | 0.29 μ m | LMM 600 Universal Length Measuring Machine |
| Surface Roughness Testers ^{1,5} (Ra Mode) | 16.1 μ in 119.5 μ in | 6.1 μ in 6.1 μ in | GAR Precision Reference Standard |
| Standard Line Scales | Up to 100 mm | 0.37 μ m | Universal Length Measuring Machine |
| Measuring Tapes, Rulers | Up to 1 000 mm (1 to 10) m | 0.11 mm 0.21 mm | Linear Scale |
| Laser Distance Meter | Up to 5 m (5 to 110) m | 1 mm 2.8 mm | Comparison to Master Laser Distance Meter, Measuring Tape |
| Levels | Up to 30° (30 to 90)° | 0.041° 0.13° | Comparison to INSIZE ISE-2DT Digital Level |

Length – Dimensional Metrology

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|-----------------------------|---|---|
| Cylindrical Plug Gauges, Pin Gauges | Up to 100 mm | 11 nm/mm + 0.29 μ m | LMM 600 Universal Length Measuring Machine |
| Holtest/Borematic | (8 to 70) mm | 0.11 μ m/mm + 4.6 μ m | Setting Ring Set |
| Sieves | Up to 5 mm (5 to 125) mm | 4.8 μ m 47 μ m | Microscope, Digital Caliper |
| Surface Plates ¹ Local Area Flatness Only (Repeat Readings) | (12 x 12) to (72 x 144) in | 70 μ in | Mahr Repeat-o-Meter |
| Fabric Inspection/Fabric Spreading Machine ¹ Length | (0.2 to 1 000) m | 0.5 % of reading + 0.24 m | Comparison to PH-200LC-SEG Digital Tachometer |

Mass and Mass Related

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|--|---|--|
| Torque Driver, Torque Wrenches, Torque Indicators, Torque Gauges ¹ | (0.1 to 3) N·m (1 to 10) N·m (5 to 50) N·m (22 to 220) N·m (70 to 650) N·m | 0.7 % of reading + 0.39 cN·m 0.6 % of reading + 0.014 N·m 1.2 % of reading + 0.000 2 N·m 1.2 % of reading + 0.011 N·m 0.18 % of reading + 1.8 N·m | Mountz LTT-2100 Torque Analyzer; CTM 0018, CTM 0019 and BMX500F Transducers |
| Torque Testers, Torque Transducers | Up to 300 kgf·cm | 0.07 % of reading + 0.014 kgf·cm | Torque Arm, Standard Weight Set |
| Mass Determination | 1 mg to 20 g (20 to 200) g (200 to 5 000) g (5 to 20) kg | 6.4 μ g/g + 32 μ g 3.2 μ g/g + 94 μ g 7.4 μ g/g + 6.8 mg 8.7 mg/kg + 77 mg | Shimadzu Balance, OIML Class E2, F1, M1 Weight Sets per OIML R 111-1 (2004), ABBA Method. |
| Scales and Balances ^{1,3} | 1 mg to 200 g (200 to 500) g (500 to 1 000) g (1 to 6.5) kg (6.5 to 32) kg (32 to 500) kg | 2 ng/g + 11 μ g 1.85 μ g/g + 0.4 mg 2.2 μ g/g + 3.4 mg 3 μ g/g + 3.4 mg 7 μ g/g + 28 mg 0.14 g/kg + 4.1 g | OIML Class E2, Class M1, Class M2, Class F1 weights and OIML R 76-1 (2006) utilized in the calibration of the weighing system. |
| Platform Scales ^{1,3} | (500 to 2 000) kg | 0.11 g/kg + 0.11 kg | OIML Class E2, Class M1, Class M2, Class F1 weights and OIML R 76-1 (2006) utilized in the calibration of the weighing system. |

Mass and Mass Related

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|---|---|--|
| Moisture Analyzer Balance | 1 mg to 200 g (200 to 500) g (500 to 1 000) g | 2 ng/g + 11 µg 1.85 µg/g + 0.4 mg 2.2 µg/g + 0.21 mg | OIML Class E2 weights and OIML R 76-1:2006 utilized in the calibration of the weighing system. |
| Temperature | (50 to 250) °C | 0.03 % of reading + 1 °C | Fluke 714 Thermocouple Calibrator with Type T Probe |
| Crane Scales ¹ (Force) | (20 to 200) kgf (200 to 4 500) kgf (500 to 10 000) kgf | 0.46 % of reading 0.46 % of reading 0.77 % of reading | Load Cells, Digital Indicator |
| Air Leak Tester | 1.45 sccm | 0.026 sccm | Leak Standard |
| Pneumatic Gauge Pressure ¹ | (-7 to 7) kPa (-830 to 0) mbar Up to 700 kPa | 5.6 Pa 7 mbar 0.43 kPa | Fluke 718-1G Pressure Calibrator, Fluke 718-100G Pressure Calibrator, Fluke 718-300G Pressure Calibrator Wika CPG1500 Master Pressure Gauge |
| Hydraulic Gauge Pressure ¹ | Up to 7 kPa (7 to 700) kPa (5 to 69) bar Up to 1 000 bar | 2.5 Pa 0.43 kPa 53 mbar 0.59 bar | Comparison to Wika CPG1500 Master Pressure Gauge |
| Rockwell Hardness Testing Machines ¹ | 30 HRC 50 HRC | 0.97 HRC 0.97 HRC | Indirect verification using Yamamoto Scientific Standard Blocks |
| Vickers Hardness Testing Machines ¹ | 297 HV 422 HV | 6.8 HV 10 HV | |
| Force Testing Machines, Compression and Tension Force Gages ¹ | (20 to 200) kgf (200 to 4 500) kgf (500 to 10 000) kgf | 0.46 % of reading 0.46 % of reading 0.77 % of reading | Load Cells, Digital Indicator |
| Force Testing Machines, Compression and Tension Force Gages ¹ | Up to 500 gf Up to 5 kgf Up to 50 kgf | 0.17 gf 1.2 gf 2.1 gf | OIML Class F1, Class M1, Class M2 Weight Sets |
| Needle Detector ¹ | (0.8 to 5) mm | 14 µm | Test Card |
| Durometers ¹ A, B, O, C, D, DO scales Spring Force | Up to 100 Duro | 0.31 Duro | Partial Direct Verification per ISO 18898:2016 using Shimadzu Analytical Balance |

Mass and Mass Related

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--------------------------------------|-------------------------------------|---|--|
| Viscosity Cup | (5 to 5 000) cSt | 0.42 % of reading + 0.45 cSt | Cannon Standard Viscosity Solutions, Stopwatch |
| Burette | (1 to 100) ml | 1.2 nl/ml + 0.49 µl | Shimadzu/Mettler Analytical Scales, OIML Class E2 and F1 weight sets |
| Pipettes, Micropipettes ¹ | 1 µl to 100 ml | 3.4 nl/l + 57 nl | |
| Volumetric Flasks | 1 ml to 20 l | 4.9 µl/l + 0.18 ml | |
| Volumetric Flow | (0.3 to 30) slpm (30 to 50) slpm | 1.4 % of reading + 0.000 7 slpm 0.3 % of reading + 0.65 slpm | Defender 520-H Primary Air Flow Calibrator; CMQ0050 |
| Liquid Flow | (5 to 200) lpm | 4.5 % of reading + 0.012 lpm | PCE-TDS 100 Ultrasonic Flow Meter |
| Particle Counter | (0.3 to 10) µm | 10 % of reading | Comparison to Reference Particle Counter |
| Air Velocity | (2.5 to 30) m/s | 2.3 % of reading + 0.008 m/s | Omega WTM-1000 Wind Tunnel, Omega HHH91 Digital Anemometer |
| Hydrometers | (0.7 to 1.8) g/ml | 0.001 6 g/ml | Comparison to Reference Hydrometer per DLVN 293:2016 |

Photometry and Radiometry

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---|---|--|---|
| Light Meters | (100 to 1 100) Lux (1 100 to 15 000) Lux | 2.7 % of reading + 0.7 Lux 2.8 % of reading + 1.5 Lux | Comparison to Konica Minolta CL-200A Chroma Meter |
| Light Box Correlated Color Temperature | (2 500 to 6 500) K | 2.15 % of reading + 16 K | Konica Minolta CL-200A Chroma Meter |
| Gloss Meters ² 60° | 37 GU 97 GU | 1.5 GU 1.5 GU | Reference Gloss Tiles |
| UV-VIS Spectrophotometers Wavelength | (440 to 635) nm | 0.45 % of reading + 0.12 nm | Spectrophotometer Calibration Kit |
| Absorbance | Up to 1 AU | 0.3 % of reading + 0.002 4 AU | |
| UV (Measure) | Up to 450 mW/cm ² | 8 % of reading + 0.7 mW/cm ² | USHIO Unimeter |

Thermodynamic

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|---|---|--|
| Temperature – Source ¹ (for Temperature Probe Cal) | (-25 to 0) °C (0 to 155) °C (120 to 650) °C | 0.14 °C 0.04 % of reading + 0.14 °C 0.12 % of reading + 0.17 °C | Temperature Calibrators: MAGMAN 650H, PRESYS T-25N, Water Bath |
| Dry Ovens, Vacuum Ovens, Environmental Chambers, Furnaces, Autoclaves, Incubators ¹ Temperature Pressure | (-80 to -45) °C (-45 to 650) °C (20 to 140) °C Up to 5 bar | 1.7 °C 2.4 °C 0.3 % of reading + 0.25 °C 36 mbar | Omega OM-CP-PRTEMP140-LVL High Temp/Pressure Datalogger, Type K Thermocouple Probe, Type T Thermocouple Probe |
| Relative Humidity – Source/Measure ³ | (10 to 97) %RH | 0.16 % of reading + 2.6 %RH | Vaisala HMM100 Humidity Module, Agilent 34970A Datalogger |
| Temperature – Measure ¹ | (-70 to 50) °C (0 to 400) °C | 0.009 3 % of reading + 0.048 °C 0.005 % of reading + 0.048 °C | AccuMac PRT, Agilent 3458A 8.5 Digit Multimeter |
| Infrared Thermometers ¹ | (0 to 50) °C (50 to 400) °C | 0.53 °C 2 °C | PRESYS T-25N+ Blackbody Source (Cavity); Omega BB703 Blackbody Source (Flat Plate) $\epsilon = 0.95, \lambda = (8 \text{ to } 14) \mu\text{m}$ |

Time and Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|----------------------------------|---|--|--|
| Stopwatches, Timers ¹ | 10 ms to 3 600 s | 19 ms | Agilent 53131A Counter; NIST SP 960-12 Method 6A |
| Frequency – Source ¹ | 100 mHz to 119.99 Hz (30 to 500) Hz 500 Hz to 225 MHz 225 MHz to 3.2 GHz | 5.3 μHz/Hz + 1.2 mHz 1 nHz/Hz + 1.4 μHz 0.4 mHz/MHz + 0.1 Hz 0.57 mHz/MHz + 0.37 Hz | Hewlett Packard 8648C Signal Generator |

Time and Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|--|---|---|
| Frequency – Measure ¹ | (30 to 500) Hz 500 Hz to 225 MHz 225 MHz to 12 GHz | 1 nHz/Hz + 1.4 μHz 0.4 mHz/MHz + 0.1 Hz 1.2 mHz/MHz + 0.37 Hz | Agilent 53131A Frequency Counter |
| Non-contact Tachometers ^{1,2} | (6 to 100 000) rpm | 0.004 % of reading + 0.12 rpm | LED, Fluke 5502A Multiproduct Calibrator |
| Speed Measurement ^{1,2} Non-contact Surface Speed | (6 to 100 000) rpm (1 to 400) m/min | 0.008 % of reading + 1.5 rpm 0.5 % of reading + 0.17 m/min | Comparison to PH-200LC-SEG Digital Tachometer |

Services performed at satellite location

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Acoustics and Vibration

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|---|--|--|
| Sound Level Meter ¹ | 1 kHz 94 dB 114 dB | 0.57 dB 0.57 dB | Soundtek ST-120 Sound Level Calibrator |
| Vibration ¹ Acceleration Velocity Displacement | 9.8 m/s ² , 159 Hz 9.8 mm/s, 159 Hz 9.9 μm | 4.2 % of reading 4.2 % of reading 4.2 % of reading | PCB Calibration Exciter |

Chemical Quantities

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|-------------------------|-----------------------|---|--|
| pH Measure ⁵ | 4 pH 7 pH 10 pH | 0.018 pH 0.021 pH 0.021 pH | Standard pH Solutions |

Chemical Quantities

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|-----------------------------------|--|--|--|
| Conductivity Measure ⁵ | 2 µS/cm 5 µS/cm 84 µS/cm 1413 µS/cm 12.88 mS/cm 111.8 mS/cm | 0.23 µS/cm 0.19 µS/cm 1.5 µS/cm 24 µS/cm 0.24 mS/cm 1.9 mS/cm | Standard Conductivity Solutions |
| Refractometers | Up to 53 %Brix | 0.27 %Brix | Comparison to Reference Refractometer, Sucrose Solutions |
| Salinity Refractometer | Up to 10 %Salinity | 4.6 % of reading + 0.11 %Salinity | Comparison to Reference Salinity Meter, Salinity Solutions |
| TDS Meter ⁵ | 100 mg/l 1 000 mg/l | 2.7 mg/l 26 mg/l | Standard TDS Solutions |
| Chlorine Meter ⁵ | 1 mg/l | 0.021 mg/l | Standard Chlorine Solution |
| Turbidity Meter ⁵ | 100 NTU 1 000 NTU | 2 NTU 11 NTU | Standard Turbidity Calibration Solutions |
| Viscosity Meter ⁵ | (5 to 5 000) cP (5 000 to 10 000) cP | 0.4 % of reading + 1 cP 1.8 % of reading + 8.2 cP | Comparison to Reference Viscosity Meter, Cannon Standard Viscosity Solutions |
| Gas Detectors ⁵ | | | |
| H ₂ S | 0.001 5 % Concentration | 0.000 053 % Concentration | Standard Gases |
| CO | 0.005 % Concentration | 0.000 2 % Concentration | |
| CH ₄ | 50 % Concentration LEL | 1.7 % Concentration LEL | |
| O ₂ | 18 % Concentration of N ₂ | 0.63 % Concentration of N ₂ | |
| Gas Detectors – TVOC ⁵ | | | |
| I-C ₄ H ₈ | 0.001 % Concentration 0.01 % Concentration | 0.000 042 % Concentration 0.000 36 % Concentration | Standard Gases, Reference RAE Mini RAE3000 |
| Alcohol Meter ⁵ | (0 to 100) %Volume | 0.82 %Volume | Comparison to Reference Alcohol Meter, Alcohol Solutions |



ANSI National Accreditation Board

Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|---|---|--|
| DC Voltage – Measure ¹ | Up to 100 mV 100 mV to 1 V (1 to 10) V (1V to 100) V (100 to 1 000) V | 17 μ V/V + 3.3 μ V 9.2 μ V/V + 0.24 μ V 8.9 μ V/V + 6.6 μ V 11 μ V/V + 1.4 μ V 14 μ V/V + 99 μ V | Agilent 3458A Opt 002 8.5 Digit Multimeter |
| DC Current – Measure ¹ | Up to 100 μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A | 0.2 nA/A + 0.35 μ A 0.1 mA/A + 2.9 nA 0.1 mA/A + 28 nA 0.1 mA/A + 0.33 μ A 0.1 mA/A + 0.33 μ A | Agilent 3458A Opt 002 8.5 Digit Multimeter |
| DC Current – Measure ¹ | (1 to 3) A (3 to 10) A (10 to 100) A | 1.3 mA/A + 0.8 mA 1.4 mA/A + 1.3 mA 12 mA/A + 0.17 A | Agilent 34401A 6.5 Digit Multimeter, Keysight 34461A 6.5 Digit Multimeter, Current Shunt |
| | (100 to 400) A | 22 mA/A + 0.9 A | Kyoritsu Kewsnap 2009R Clamp Meter |
| DC Voltage – Source ¹ | Up to 329.999 9 mV (0.33 to 3.299 999) V (3.3 to 32.999 99) V (33 to 329.999 9) V (330 to 1 020) V | 70 nV/mV + 3.6 μ V 59 nV/V + 66 μ V 59 nV/V + 61 μ V 65 μ V/V + 0.59 mV 64 μ V/V + 2.1 mV | Fluke 5502A Multiproduct Calibrator |
| DC Current – Source ¹ | Up to 329.999 μ A (0.33 to 3.299 99) mA (3.3 to 32.999 9) mA (33 to 329.999) mA (0.33 to 1.099 99) mA (1.1 to 2.999 99) A (3 to 10.999 9) A (11 to 20.5) A | 0.17 nA/ μ A + 24 nA 0.12 μ A/mA + 79 nA 0.12 μ A/mA + 0.54 μ A 0.14 μ A/mA + 5.5 μ A 0.45 mA/A + 82 μ A 0.43 μ A/A + 0.1 mA 0.69 mA/A + 0.89 mA 1.2 mA/A + 1.2 mA | Fluke 5502A Multiproduct Calibrator |
| DC Current Clamp-on Meters ¹ | (20.5 to 1 000) A | 16 mA/A + 0.95 A | Fluke 5502A Multiproduct Calibrator, Current Coil |



ANSI National Accreditation Board

Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|-----------------------------------|---------------------|---|---|
| AC Voltage – Measure ¹ | Up to 100 mV | | Agilent 3458A Opt 002 8.5 Digit Multimeter |
| | 40 Hz to 1 kHz | 0.21 μ V/mV + 1.6 μ V | |
| | (1 to 20) kHz | 0.25 μ V/mV + 1.9 μ V | |
| | (20 to 50) kHz | 0.46 μ V/mV + 2 μ V | |
| | (50 to 100) kHz | 1.4 μ V/mV + 1.6 μ V | |
| | (0.1 to 1) V | | |
| | 40 Hz to 1 kHz | 0.13 mV/V + 21 μ V | |
| | (1 to 20) kHz | 0.18 mV/V + 22 μ V | |
| | (20 to 50) kHz | 0.36 mV/V + 23 μ V | |
| | (50 to 100) kHz | 0.97 mV/V + 22 μ V | |
| | (1 to 10) V | | |
| | 40 Hz to 1 kHz | 0.13 mV/V + 0.21 mV | |
| (1 to 20) kHz | 0.19 mV/V + 0.22 mV | | |
| (20 to 50) kHz | 0.36 mV/V + 0.23 mV | | |
| (50 to 100) kHz | 0.97 mV/V + 0.22 mV | | |
| AC Voltage – Measure ¹ | (10 to 100) V | | Agilent 3458A Opt 002 8.5 Digit Multimeter |
| | 40 Hz to 1 kHz | 0.25 mV/V + 2.2 mV | |
| | (1 to 20) kHz | 0.25 mV/V + 2.2 mV | |
| | (20 to 50) kHz | 0.5 mV/V + 2 mV | |
| | (50 to 100) kHz | 1.4 mV/V + 2.3 mV | |
| | (100 to 750) V | | |
| 50 Hz to 1 kHz | 0.47 mV/V + 17 mV | | |



ANSI National Accreditation Board

Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|----------------------------------|----------------------|---|--|
| AC Voltage – Source ¹ | (1 to 32.999) mV | | Fluke 5502A Multiproduct Calibrator |
| | (10 to 45) Hz | 1.7 μ V/mV + 23 μ V | |
| | 45 Hz to 10 kHz | 1.2 μ V/mV + 23 μ V | |
| | (10 to 20) kHz | 1.7 μ V/mV + 23 μ V | |
| | (20 to 50) kHz | 2.3 μ V/mV + 23 μ V | |
| | (50 to 100) kHz | 4 μ V/mV + 38 μ V | |
| | (100 to 500) kHz | 11 μ V/mV + 71 μ V | |
| | (33 to 329.999) mV | | |
| | (10 to 45) Hz | 0.58 μ V/mV + 23 μ V | |
| | 45 Hz to 10 kHz | 0.36 μ V/mV + 19 μ V | |
| | (10 to 20) kHz | 0.81 μ V/mV + 23 μ V | |
| | (20 to 50) kHz | 1.2 μ V/mV + 47 μ V | |
| | (50 to 100) kHz | 2.6 μ V/mV + 0.2 mV | |
| | (100 to 500) kHz | 5.8 μ V/mV + 0.39 mV | |
| | (0.33 to 3.299 99) V | | |
| | (10 to 45) Hz | 0.58 mV/V + 71 μ V | |
| | 45 Hz to 10 kHz | 0.35 mV/V + 72 μ V | |
| | (10 to 20) kHz | 0.81 mV/V + 0.69 mV | |
| | (20 to 50) kHz | 1.2 mV/V + 0.7 mV | |
| | (50 to 100) kHz | 2.7 mV/V + 0.24 mV | |
| | (100 to 500) kHz | 5.8 mV/V + 1.2 mV | |
| | (3.3 to 32.999 9) V | | |
| | (10 to 45) Hz | 0.58 mV/V + 0.94 mV | |
| | 45 Hz to 10 kHz | 0.35 mV/V + 0.72 mV | |
| (10 to 20) kHz | 0.81 mV/V + 0.8 mV | | |
| (20 to 50) kHz | 1.2 mV/V + 0.84 mV | | |
| (50 to 100) kHz | 2.7 mV/V + 2.4 mV | | |
| (33 to 329.999) V | | | |
| (10 to 45) Hz | 0.58 mV/V + 3.7 mV | | |
| 45 Hz to 10 kHz | 0.92 mV/V + 11 mV | | |
| (10 to 20) kHz | 1 mV/V + 12 mV | | |
| (20 to 50) kHz | 1.4 mV/V + 14 mV | | |
| (50 to 100) kHz | 2.7 mV/V + 0.11 V | | |
| AC Voltage – Source ¹ | (330 to 1 020) V | | Fluke 5502A Multiproduct Calibrator |
| | 45 Hz to 1 kHz | 0.58 mV/V + 23 mV | |
| | (1 to 5) kHz | 0.92 mV/V + 25 mV | |
| | (5 to 10) kHz | 1 mV/V + 26 mV | |



ANSI National Accreditation Board

Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|----------------------------------|------------------------|---|--|
| AC Current – Source ¹ | (29 to 329.99) μ A | | Fluke 5502A Multiproduct Calibrator |
| | (10 to 20) Hz | 2.3 nA/ μ A + 0.12 μ A | |
| | (20 to 45) Hz | 1.7 nA/ μ A + 0.12 μ A | |
| | 45 Hz to 1 kHz | 1.4 nA/ μ A + 0.12 μ A | |
| | (1 to 5) kHz | 2.3 nA/ μ A + 0.21 μ A | |
| | (5 to 10) kHz | 9.3 nA/ μ A + 0.23 μ A | |
| | (10 to 30) kHz | 7.7 nA/ μ A + 0.77 μ A | |
| | (0.33 to 3.299 99) mA | | |
| | (10 to 20) Hz | 2.3 μ A/mA + 0.21 μ A | |
| | (20 to 45) Hz | 1.4 μ A/mA + 0.2 μ A | |
| | 45 Hz to 1 kHz | 1.1 μ A/mA + 0.2 μ A | |
| | (1 to 5) kHz | 2.3 μ A/mA + 0.26 μ A | |
| | (5 to 10) kHz | 5.8 μ A/mA + 0.37 μ A | |
| | (10 to 30) kHz | 11 μ A/mA + 0.75 μ A | |
| | (3.3 to 32.99 99) mA | | |
| | (10 to 20) Hz | 2.9 μ A/mA + 3.4 μ A | |
| | (20 to 45) Hz | 0.69 μ A/mA + 20 μ A | |
| | 45 Hz to 1 kHz | 0.81 μ A/mA + 1.6 μ A | |
| | (1 to 5) kHz | 0.92 μ A/mA + 2.7 μ A | |
| | (5 to 10) kHz | 2.3 μ A/mA + 3.6 μ A | |
| | (10 to 30) kHz | 4.6 μ A/mA + 4.8 μ A | |
| | (33 to 329.999) mA | | |
| | (10 to 20) Hz | 2 μ A/mA + 35 μ A | |
| | (20 to 45) Hz | 1 μ A/mA + 30 μ A | |
| | 45 Hz to 1 kHz | 0.46 μ A/mA + 25 μ A | |
| | (1 to 5) kHz | 1.2 μ A/mA + 59 μ A | |
| | (5 to 10) kHz | 2.3 μ A/mA + 0.12 mA | |
| | (10 to 30) kHz | 4.6 μ A/mA + 0.23 mA | |
| (0.33 to 1.099 99) A | | | |
| (10 to 45) Hz | 2.1 mA/A + 0.12 mA | | |
| 45 Hz to 1 kHz | 0.46 mA/A + 30 μ A | | |
| (1 to 5) kHz | 6.9 mA/A + 1.2 mA | | |
| (5 to 10) kHz | 28 mA/A + 5.8 mA | | |
| (1 to 2.999 99) A | | | |
| (10 to 45) Hz | 2 mA/A + 0.13 mA | | |
| 45 Hz to 1 kHz | 0.69 mA/A + 0.16 mA | | |
| (1 to 5) kHz | 7 mA/A + 1.2 mA | | |
| (5 to 10) kHz | 28 mA/A + 5.9 mA | | |

Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|--|---|--|
| AC Current – Source ¹ | (3 to 10.999 9) A (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (11 to 20.5) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz | 0.69 mA/A + 2.4 mA 1.2 mA/A + 2.4 mA 34 mA/A + 2.4 mA 1.4 mA/A + 5.8 mA 1.4 mA/A + 5.9 mA 34.6 mA/A + 5.8 mA | Fluke 5502A Multiproduct Calibrator |
| AC Current Clamp-on Meters ¹ | (20.5 to 1 000) A 50 Hz | 9.1 mA/A + 0.49 A | Fluke 5502A Multiproduct Calibrator, Current Coil |
| AC Current – Measure ¹ | Up to 100 μ A (45 to 100) Hz 100 Hz to 5 kHz (0.1 to 1) mA (45 to 100) Hz 100 Hz to 5 kHz (1 to 10) mA (45 to 100) Hz 100 Hz to 5 kHz (10 to 100) mA (45 to 100) Hz 100 Hz to 5 kHz | 0.82 nA/ μ A + 34 nA 0.82 nA/ μ A + 34 nA 0.88 μ A/mA + 0.22 μ A 0.88 μ A/mA + 0.22 μ A 0.88 μ A/mA + 2.2 μ A 0.4 μ A/mA + 2.2 μ A 0.83 μ A/mA + 22 μ A 0.55 μ A/mA + 22 μ A | Agilent 3458A Opt 002 8.5 Digit Multimeter |
| AC Current – Measure ¹ | (0.1 to 1) A (45 to 100) Hz 100 Hz to 5 kHz | 1.1 mA/A + 0.22 mA 1.3 mA/A + 0.22 mA | Agilent 3458A Opt 002 8.5 Digit Multimeter |
| | (1 to 3) A 10 Hz to 5 kHz | 1.5 mA/A + 3.4 mA | Agilent 34401A 6.5 Digit Multimeter, |
| | (3 to 10) A 3 Hz to 5 kHz | 2.1 mA/A + 5.2 mA | Keysight 34461A 6.5 Digit Multimeter |
| | (10 to 400) A 50 Hz | 17.4 mA/A + 0.61 A | Kyoritsu Kewsnap 2009R Current Clamp Meter |
| Oscilloscopes ¹ Amplitude – DC Signal into 50 Ω Load into 1 M Ω Load Amplitude – Square Wave into 50 Ω Load into 1 M Ω Load | Up to 2.2 V Up to 33 V 1.8 mVp-p to 2.2 Vp-p 10 Hz to 10 kHz 1.8 mVp-p to 105 Vp-p 10 Hz to 10 kHz | 3.7 mV/V + 4.8 mV 2.6 mV/V + 10 mV 1.7 mV/V + 3.9 mV 2.8 mV/V + 1.9 mV | Fluke 5520A/SC300 Multiproduct Calibrator with 300 MHz Scope Option |

Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|---|--|--|
| Oscilloscopes ¹ Amplitude – Leveled Sine Wave into 50 Ω Load | 5 mVp-p to 5.5 Vp-p 50 kHz 50 kHz to 100 MHz (100 to 300) MHz | 25 mV/V + 5.7 mV 45 mV/V + 3.8 mV 51 mV/V + 5 mV | Fluke 5520A/SC300 Multiproduct Calibrator with 300 MHz Scope Option |
| Time Marker | (2 to 10) ns 20 ns to 1 μs (2 to 50) μs 100 μs to 5 s | 0.56 ps 11 ps/μs + 40 ps 16 ps/μs + 0.1 ns 0.23 ms/s + 7 μs | |
| Wave Generator (Square, Sine, Triangle Wave) into 50 Ω Load | 1.8 mVp-p to 2.2 Vp-p 10 Hz to 100 kHz | 39 mV/V + 0.38 mV | |
| into 1 MΩ Load | 1.8 mVp-p to 55 Vp-p 10 Hz to 100 kHz | 39 mV/V + 1.7 mV | |
| DC Resistance – Source ¹ (Variable Artifact) (LCR Meters) | (10 to 100) mΩ (0.1 to 1) Ω (1 to 10) Ω (10 to 100) Ω (100 to 1 000) Ω (1 to 10) kΩ (10 to 40) kΩ | 0.15 mΩ/Ω + 1.8 mΩ 0.11 mΩ/Ω + 1.8 mΩ 0.11 mΩ/Ω + 4.2 mΩ 47 μΩ/Ω + 26 nΩ 0.11 mΩ/Ω + 60 mΩ 86 mΩ/kΩ + 1 Ω 60 mΩ/kΩ + 5.8 Ω | General Radio 1433-M Decade Resistor |
| Capacitance – Source ¹ (Variable Artifact) (LCR Meters – 1 kHz) | (10 to 100) pF (100 to 1 000) pF (1 to 10) nF (10 to 100) nF (0.1 to 1) μF | 55 fF/pF + 5.8 pF 5.7 fF/pF + 5.9 pF 5.6 fF/pF + 8.2 pF 5.8 nF/μF + 5.8 nF 5.8 nF/μF + 5.8 nF | General Radio 1412-BC Decade Capacitor |
| Inductance – Source ¹ (Variable Artifact) (LCR Meters - 1 kHz) | (1 to 10) mH (10 to 100) mH (0.1 to 1) H (1 to 10) H | 9.3 μH/mH + 0.1 μH 9.3 μH/mH + 1.6 μH 9.3 μH/mH + 8.6 μH 9.3 μH/H + 80 μH | General Radio 1490-D Decade Inductor |



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Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---|--|--|---|
| Hipot Testers, Spark Testers, Surge Testers, Impulse Winding Testers ¹ AC Cut-off Current | 50/60 Hz (29 to 500) μ A (500 to 5 000) μ A (5 to 50) mA (50 to 100) mA | 7 nA/ μ A + 0.28 μ A 7 nA/ μ A + 0.62 μ A 7 μ A/mA + 23 μ A 7 μ A/mA + 62 μ A | Resistance Box, Fluke 287 Digital Multimeter |
| DC Cut-off Current | Up to 500 μ A (500 to 5 000) μ A (5 to 50) mA (50 to 100) mA | 0.91 nA/ μ A + 0.23 μ A 0.82 nA/ μ A + 0.76 μ A 0.6 μ A/mA + 13 μ A 1.6 μ A/mA + 36 μ A | |
| AC High Voltage | 50 Hz Up to 4.24 kV (4.24 to 25) kV | 15 V/kV + 4 V 61 V/kV + 23 V | Fluke 287 DMM, High Voltage Probe |
| Ground Bond Tester ¹ | Up to 500 m Ω | 0.01 % of reading + 1.7 m Ω | General Resistance RDS41-A Decade Resistor |
| Withstanding/Insulation Testers ¹ DC Voltage | Up to 6 kV (6 to 35) kV | 13 V/kV 23 V/kV + 19 V | Time Electronics 5069 Insulation Tester Calibrator, Fluke 287 DMM, High Voltage Probe |
| DC Current | Up to 2 mA (2 to 20) mA | 23 μ A 0.23 mA | |
| Resistance | (0.1 to 5) M Ω (10 to 100) M Ω (10 to 1 000) M Ω (1 to 10) G Ω (10 to 100) G Ω | 8.4 k Ω /M Ω + 19 k Ω 12 k Ω /M Ω + 1.1 k Ω 12 k Ω /M Ω + 9.1 k Ω 15 M Ω /G Ω + 1.7 M Ω 58 M Ω /G Ω + 12 M Ω | |
| Resistance – Source ¹ (Simulated) | (3.3 to 11) k Ω (11 to 32.999 9) k Ω (33 to 109.999) k Ω (110 to 329.999) k Ω 330 k Ω to 1.099 99 M Ω (1.1 to 3.299 99) M Ω (3.3 to 10.999 9) M Ω (11 to 32.999 9) M Ω (33 to 109.999) M Ω (110 to 329.999) M Ω (330 to 1 100) M Ω | 0.1 Ω /k Ω + 74 m Ω 0.1 Ω /k Ω + 0.24 Ω 0.13 Ω /k Ω + 0.44 Ω 0.14 Ω /k Ω + 2.4 Ω 0.17 k Ω /M Ω + 5.5 Ω 0.17 k Ω /M Ω + 35 Ω 0.69 k Ω /M Ω + 61 Ω 1.2 k Ω /M Ω + 2.9 k Ω 5.8 k Ω /M Ω + 3.4 k Ω 5.8 k Ω /M Ω + 0.12 M Ω 17 k Ω /M Ω + 0.57 M Ω | Fluke 5502A Multiproduct Calibrator |



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Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---|---|---|---|
| Resistance – Measure ¹ | Up to 10 Ω (10 to 100) Ω (0.1 to 1) kΩ (1 to 10) kΩ (10 to 100) kΩ (0.1 to 1) MΩ (1 to 10) MΩ (10 to 100) MΩ | 54 μΩ/Ω + 97 μΩ 14 μΩ/Ω + 0.64 mΩ 14 mΩ/kΩ + 0.87 mΩ 13 mΩ/kΩ + 10 mΩ 11 mΩ/kΩ + 0.26 Ω 34 Ω/MΩ + 2.8 Ω 70 Ω/MΩ + 100 Ω 0.59 kΩ/MΩ + 1.1 kΩ | Agilent 3458A Opt 002 8.5 Digit Multimeter |
| Capacitance (Simulated) ¹ 10 Hz to 10 kHz 10 Hz to 10 kHz 10 Hz to 3 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz (10 to 50) Hz (10 to 20) Hz DC to 6 Hz DC to 2 Hz DC to 0.6 Hz DC to 0.2 Hz | (220 to 399.9) pF 400 pF to 1.099 9 nF (1.1 to 3.299 9) nF (3.3 to 10.999) nF (11 to 32.999) nF (33 to 109.99) nF (110 to 329.99) nF (0.33 to 1.099 9) μF (1.1 to 3.299 9) μF (3.3 to 10.999) μF (11 to 32.999) μF (33 to 109.99) μF (110 to 329.99) μF 330 μF to 1.099 9 mF (1.1 to 3.299 9) mF (3.3 to 10.999) mF (11 to 32.999) mF (33 to 110) mF | 5.8 fF/pF + 12 pF 5.7 pF/nF + 12 pF 5.8 pF/nF + 12 pF 2.9 pF/nF + 12 pF 2.9 pF/nF + 12 pF 2.9 pF/nF + 0.12 nF 3 pF/nF + 0.35 nF 3 nF/μF + 1.1 nF 3 nF/μF + 3.4 nF 3 nF/μF + 11 nF 4.7 nF/μF + 35 nF 5.4 nF/μF + 0.11 μF 5.2 nF/μF + 0.36 μF 5.2 μF/mF + 1.2 μF 5.2 μF/mF + 3.5 μF 5.2 μF/mF + 12 μF 8.4 μF/mF + 41 μF 13 μF/mF + 0.12 mF | Fluke 5502A Multiproduct Calibrator |
| Electrical Simulation of Thermocouple Indicating Devices – Source/Measure ¹ | Type B (600 to 800) °C (800 to 1 000) °C (1 000 to 1 550) °C (1 550 to 1 820) °C Type E (-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C | 0.59 °C 0.48 °C 0.44 °C 0.47 °C 0.8 °C 0.46 °C 0.48 °C 0.57 °C 0.5 °C | Fluke 5502A Multiproduct Calibrator |



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Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|-------------------------|---|--|
| Electrical Simulation of Thermocouple Indicating Devices – Source/Measure ¹ | Type J | | Fluke 5502A Multiproduct Calibrator |
| | (-210 to -100) °C | 0.43 °C | |
| | (-100 to -30) °C | 0.32 °C | |
| | (-30 to 150) °C | 0.34 °C | |
| | (150 to 760) °C | 0.36 °C | |
| | (760 to 1200) °C | 0.39 °C | |
| | Type K | | |
| | (-200 to -100) °C | 0.48 °C | |
| | (-100 to -25) °C | 0.34 °C | |
| | (-25 to 120) °C | 0.29 °C | |
| | (120 to 1000) °C | 0.4 °C | |
| | (1000 to 1372) °C | 0.53 °C | |
| | Type R | | |
| | (0 to 250) °C | 0.72 °C | |
| | (250 to 400) °C | 0.56 °C | |
| (400 to 1 000) °C | 0.47 °C | | |
| (1 000 to 1 767) °C | 0.6 °C | | |
| Type T | | | |
| (-250 to -150) °C | 0.82 °C | | |
| (-150 to 0) °C | 0.4 °C | | |
| (0 to 120) °C | 0.3 °C | | |
| (120 to 400) °C | 0.32 °C | | |
| Tesla Meter, Gauss Meter | 3 mT 50 mT 500 mT | 0.24 mT 2.4 mT 13 mT | Reference Magnetic Field Block |

Electrical – RF/Microwave

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment | |
|--------------------------------|-------------------|---|--|--|
| RF Power – Source ¹ | 100 kHz to 50 MHz | (-70 to 0) dBm | 1.3 dB | Hewlett Packard 8648C Signal Generator |
| | | (0 to 13) dBm | 1.3 dB | |
| | 50 MHz to 2.5 GHz | (-70 to -25.9) dBm | 1.3 dB | |
| | | (-25.9 to 0) dBm | 1.2 dB | |
| | | (0 to 13) dBm | 1.2 dB | |
| | (2.5 to 3.2) GHz | (-70 to -25.9) dBm | 1.8 dB | |
| | | (-25.9 to 0) dBm | 1.8 dB | |
| | | (0 to 13) dBm | 1.8 dB | |

Electrical – RF/Microwave

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---|-------------------------------------|---|---|
| RF Power – Measure ¹ 10 MHz to 18 GHz | (-60 to -20) dBm (-20 to 20) dBm | 1.3 dB 1.2 dB | Agilent E4418B Power Meter, HP 9300A Power Meter |

Length – Dimensional Metrology

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---|--|---|---|
| Calipers ¹ | Up to 600 mm | 7.4 nm/mm + 10 µm | Gauge Blocks |
| Micrometers ¹ | Up to 25.4 mm (25.4 to 500) mm | 8.3 nm/mm + 0.22 µm 11 nm/mm + 1.5 µm | Optical Flat, Gauge Blocks |
| Height Gauges ¹ | Up to 600 mm | 15 nm/mm + 0.3 µm | Gauge Blocks |
| Depth Gauges ¹ | Up to 500 mm | 10 nm/mm + 12 µm | Gauge Blocks |
| Coordinate Measuring Machines ¹ (CMM) | X-axis: Up to 600 mm Y-axis: Up to 600 mm Z-axis: Up to 500 mm | 15 nm/mm + 0.42 µm 15 nm/mm + 0.34 µm 15 nm/mm + 0.6 µm | Grade 0 Gauge Blocks, Grade 0 Long Gauge Blocks |
| Measuring Microscopes, Vision Systems ¹ | X-Y Axis: Up to 300 mm | 12 nm/mm + 0.94 µm | Grade 0 Gauge Blocks, Grade 0 Long Gauge Blocks |
| Profile Projectors ¹ | X-Y Axis: Up to 300 mm | 13 nm/mm + 0.68 µm | Grade 0 Gauge Blocks, Grade 0 Long Gauge Blocks |
| Laser Micrometers | Up to 100 mm | 0.6 µm | Pin Gauge Set, Grade 0 Gauge Blocks |
| Coating Thickness Meters ¹ | (25 to 1 500) µm | 2.9 µm | Coating Thickness Standards |
| Dial Indicators, Dial Indicators ¹ | Up to 100 mm | 9.5 nm/mm + 1.1 µm | Gauge Blocks |
| Surface Roughness Testers ¹ (Ra Mode) | 16.1 µin | 4.2 µin | GAR Precision Reference Standard |
| Measuring Tapes, Rulers | Up to 1 000 mm (1 to 10) m | 0.11 mm 0.27 mm | Linear Scale |
| Laser Distance Meter | Up to 5 m (5 to 110) m | 1 mm 3.1 mm | Measuring Tape, Laser Distance Meter |
| Holtest/Borematic | (8 to 70) mm | 0.11 µm/mm + 4.6 µm | Setting Ring Set |



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Length – Dimensional Metrology

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|----------------------------|---|---|
| Levels | Up to 30° (30 to 90)° | 0.042° 0.14° | Comparison to INSIZE ISE-2DT Digital Level |
| Surface Plates ¹ Local Area Flatness Only (Repeat Readings) | (12 x 12) to (72 x 144) in | 57 µin | Mahr Repeat-o-Meter |
| Fabric Inspection/Fabric Spreading Machine ¹ Length | (0.2 to 1 000) m | 0.5 % of reading + 0.22 m | Comparison to PH-200LC-SEG Digital Tachometer |

Mass and Mass Related

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|--|---|--|
| Torque Driver, Torque Wrenches, Torque Indicators, Torque Gauges ¹ | (0.1 to 3) N·m (1 to 10) N·m (5 to 50) N·m (22 to 220) N·m (70 to 650) N·m | 0.8 % of reading + 0.026 cN·m 0.7 % of reading + 0.006 N·m 1.2 % of reading + 0.007 N·m 1.2 % of reading + 0.07 N·m 0.18 % of reading + 1.8 N·m | Mountz LTT-2100 Torque Analyzer; CTM 0018, CTM 0019 and BMX500F Transducers |
| Torque Testers, Torque Transducers | Up to 300 kgf·cm | 0.07 % of reading + 0.021 kgf·cm | Torque Arms, Standard Weights |
| Mass Determination | 1 mg to 20 g (20 to 200) g (200 to 5 000) g (5 to 20) kg | 3.8 µg/g + 52 µg 1.9 µg/g + 0.15 mg 13.9 µg/g + 3.6 mg 56.3 mg/kg + 0.46 g | Shimadzu Balance, OIML Class E2, F1, M1 Weight Sets per OIML R 111-1 (2004), ABBA Method. |
| Scales and Balances ^{1,3} | 1 mg to 200 g (200 to 500) g (500 to 1 000) g (1 to 6.5) kg (6.5 to 32) kg (32 to 500) kg | 5 µg/g + 15 µg 1.6 µg/g + 0.11 mg 1.6 µg/g + 1 mg 7.3 µg/g + 8.8 g 28 mg/kg + 28 mg 0.14 g/kg + 4.1 g | OIML Class E2, Class M1, Class M2, Class F1 weights and OIML R 76-1 (2006) utilized in the calibration of the weighing system. |
| Platform Scales ^{1,3} | (500 to 2 000) kg | 0.22 g/kg + 0.11 kg | OIML Class E2, Class M1, Class M2, Class F1 weights and OIML R 76-1 (2006) utilized in the calibration of the weighing system. |
| Crane Scales ¹ (Force) | (20 to 200) kgf (200 to 4 500) kgf (500 to 10 000) kgf | 0.47 % of reading 0.47 % of reading 0.77 % of reading | Load Cells, Digital Indicator |
| Air Leak Tester | 1.45 sccm | 0.026 sccm | Leak Standard |

Mass and Mass Related

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|--|---|---|
| Pneumatic Gauge Pressure ¹ | (-7 to 7) kPa (-0.8 to 20) bar Up to 1 000 bar | 5.6 Pa 7 mbar 0.58 bar | Fluke 718-1G Pressure Calibrator, Fluke 718-100G Pressure Calibrator, Fluke 718-300G Pressure Calibrator, Wika CPG1500 Master Pressure Gauge |
| Hydraulic Gauge Pressure ¹ | Up to 7 kPa Up to 20 bar Up to 1 000 bar | 5.6 Pa 7 mbar 0.58 bar | |
| Rockwell Hardness Testing Machines ¹ | 30 HRC 50 HRC | 0.89 HRC 0.91 HRC | Indirect verification using Yamamoto Scientific Standard Blocks |
| Vickers Hardness Testing Machines ¹ | 297 HV 422 HV | 4.9 HV 10 HV | |
| Force Testing Machines, Compression and Tension Force Gages ¹ | (20 to 200) kgf (200 to 4 500) kgf (500 to 10 000) kgf | 0.47 % of reading 0.47 % of reading 0.77 % of reading | Load Cells, Digital Indicator |
| Force Testing Machines, Compression and Tension Force Gages ¹ | Up to 500 gf Up to 5 kgf Up to 50 kgf | 0.17 gf 1.2 gf 2.1 gf | OIML Class F1, Class M1, Class M2 Weight Sets |
| Needle Detector ¹ | (0.8 to 5) mm | 59 µm | Test Card |
| Durometers ¹ A, B, O, C, D, DO scales Spring Force | Up to 100 Duro | 0.31 Duro | Partial Direct Verification per ISO 18898:2016 using Shimadzu Analytical Balance |
| Burette | (1 to 100) ml | 1.1 nl/ml + 0.49 µl | Analytical Scales: Shimadzu AUX 220, Shimadzu UX 620H, Shimadzu UX 6200H; Jadever JWN-30k Weight Set |
| Pipettes, Micropipettes ¹ | 1 µl to 100 ml | 4.3 ml/l + 0.8 µl | Comparison with Analytical Balance |
| Volumetric Flasks | 1 ml to 20 l | 69 ml/l + 1.3 ml | Comparison with Analytical Balance |
| Volumetric Flow | (0.3 to 30) slpm (30 to 50) slpm | 1.4 % of reading + 0.004 slpm 0.3 % of reading + 0.56 slpm | Defender 520-H Primary Air Flow Calibrator; CMQ0050 |
| Hydrometers | (0.7 to 1.8) g/ml | 0.001 4 g/ml | Comparison to Reference Hydrometers per DLVN 293:2016; Manufacturer's Manual |

Mass and Mass Related

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---------------------|---------------------------|---|--|
| Viscosity Cup | (5 to 5 000) cSt | 0.42 % of reading + 0.49 cSt | Cannon Standard Viscosity Solutions, Stopwatch |
| Liquid Flow | (5 to 200) lpm | 4.5 % of reading + 0.012 lpm | PCE-TDS 100 Ultrasonic Flow Meter |
| Particle Counter | (0.3 to 10) μm | 10 % of reading | Comparison to Reference Particle Counter |
| Air Velocity | (2.5 to 30) m/s | 2.6 % of reading + 0.003 7 m/s | Omega WTM-1000 Wind Tunnel, Omega HHF91 Digital Anemometer |

Photometry and Radiometry

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---|---|--|---|
| Light Meters | (100 to 1 100) Lux (1 100 to 15 000) Lux | 2.7 % of reading + 0.7 Lux 2.8 % of reading + 1.5 Lux | Comparison to Konica Minolta CL-200A Chroma Meter |
| Light Box Correlated Color Temperature | (2 500 to 6 500) K | 2.15 % of reading + 16 K | Konica Minolta CL-200A Chroma Meter |
| Gloss Meters ² 60 ° | 37 GU 97 GU | 2.1 GU 2.1 GU | Reference Gloss Tiles |

Thermodynamic

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|---|--|---|
| Temperature – Source ¹ (for Temperature Probe Cal) | (-25 to 0) °C (0 to 155) °C (120 to 650) °C | 0.3 % of reading + 0.16 °C 0.3 % of reading + 0.22 °C 0.2 % of reading + 0.16 °C | Temperature Calibrators: MAGMAN 650H, PRESYS T-25N, Water Bath |

Thermodynamic

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---|---|---|---|
| Dry Ovens, Vacuum Ovens, Environmental Chambers, Furnaces, Autoclaves, Incubators ¹ Temperature Pressure | (-80 to -45) °C (-45 to 650) °C (20 to 140) °C Up to 5 bar | 1.7 °C 2.4 °C 0.3 % of reading + 0.25 °C 36 mbar | Omega OM-CP-PRTEMP140-LVL High Temp/Pressure Datalogger, Type K Thermocouple Probe, Type T Thermocouple Probe |
| Relative Humidity – Source/Measure ³ | (10 to 97) %RH | 0.8 % of reading + 2.1 %RH | Vaisala HMM100 Humidity Module, Agilent 34970A Datalogger |
| Temperature – Measure ¹ | (-70 to 0) °C (0 to 450) °C | 0.04 °C 0.006 % of reading + 0.05 °C | AccuMac PRT, Agilent 3458A 8.5 Digit Multimeter |
| Infrared Thermometers ¹ | (-20 to 50) °C (50 to 400) °C | 0.45 °C 2 °C | PRESYS T-25N+ Blackbody Source (Cavity); Omega BB703 Blackbody Source (Flat Plate) $\epsilon = 0.95, \lambda = (8 \text{ to } 14) \mu\text{m}$ |

Time and Frequency

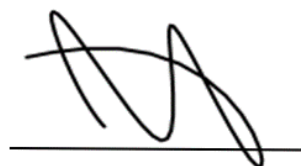
| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|---|--|---|
| Stopwatches, Timers ¹ | 10 ms to 3 600 s | 42 ms | Agilent 53131A Counter; NIST SP 960-12 Method 6A |
| Frequency – Source ¹ | 100 mHz to 119.99 Hz (30 to 500) Hz 500 Hz to 225 MHz 225 MHz to 3.2 GHz | 5.3 μHz/Hz + 1.2 mHz 1 nHz/Hz + 1.4 μHz 0.4 mHz/MHz + 0.1 Hz 0.57 mHz/MHz + 0.37 Hz | Fluke 5502A Multiproduct Calibrator, Hewlett Packard 8648C Signal Generator |
| Frequency – Measure ¹ | (30 to 500) Hz 500 Hz to 225 MHz 225 MHz to 12 GHz | 17 μHz 0.33 mHz/MHz + 0.1 Hz 1.2 mHz/MHz + 0.37 Hz | Agilent 53131A Frequency Counter |
| Non-contact Tachometers ^{1,2} | (6 to 100 000) rpm | 0.004 % of reading + 0.11 rpm | LED, Fluke 5502A Multiproduct Calibrator |

Time and Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---|--------------------|---|---|
| Speed Measurement ^{1,2} Non-contact | (6 to 100 000) rpm | 0.008 % of reading + 1.5 rpm | Comparison to PH-200LC-SEG Digital Tachometer |
| Surface Speed | (1 to 400) m/min | 0.5 % of reading + 0.21 m/min | |

Calibration and Measurement Capability (CMC) is expressed in terms of the measurement parameter, measurement range, expanded uncertainty of measurement and reference standard, method, and/or equipment. The expanded uncertainty of measurement is expressed as the standard uncertainty of the measurement multiplied by a coverage factor of 2 ($k=2$), corresponding to a confidence level of approximately 95%.

- Notes:
1. On-site calibration service is available for this parameter, since on-site conditions are typically more variable than those in the laboratory, larger measurement uncertainties are expected on-site than what is reported on the accredited scope.
 2. GU = Gloss Unit, rpm = revolutions per minute; AU = absorbance unit.
 3. The CMC for scales and balances is highly dependent upon the resolution of the unit under test. The CMC presented here does not include the resolution of the unit under test. The resolution will be included in the reported measurement uncertainty at the time of calibration.
 4. The humidity is limited to the prevailing ambient conditions in the laboratory at the time of calibration.
 5. These values are approximate values. The actual certificate value will be utilized during calibration.
 6. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2478.



Jason Stine, Vice President

