



CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

**TLC Calibrations Company, LLC
2720 Mounds View Blvd., Suite 400
Mounds View, MN 55112**

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 read "Jason Stine".

Jason Stine, Vice President

Expiry Date: 28 January 2025

Certificate Number: AC-2949



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

TLC Calibrations Company, LLC

2720 Mounds View Blvd., Suite 400

Mounds View, MN 55112

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CALIBRATION

Valid to: **January 28, 2025**

Certificate Number: **AC-2949**

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Source ¹ (Ranges Locked)	(0 to 330) mV (0 to 3.3) V (0 to 33) V (30 to 330) V (100 to 1 020) V	20 $\mu\text{V}/\text{V} + 1 \mu\text{V}$ 11 $\mu\text{V}/\text{V} + 2.1 \mu\text{V}$ 12 $\mu\text{V}/\text{V} + 21 \mu\text{V}$ 18 $\mu\text{V}/\text{V} + 0.15 \text{mV}$ 18 $\mu\text{V}/\text{V} + 1.6 \text{mV}$	Multiproduct Calibrator (Ranges Locked)
DC Voltage – Measure ¹	Up to 100 mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1 000) V	89 $\mu\text{V}/\text{V} + 0.6 \text{nV}$ 27 $\mu\text{V}/\text{V} + 6.9 \mu\text{V}$ 30 $\mu\text{V}/\text{V} + 3.9 \mu\text{V}$ 48 $\mu\text{V}/\text{V} + 0.18 \text{mV}$ 50 $\mu\text{V}/\text{V} + 0.33 \text{mV}$	8.5 Digit Multimeter
DC Current – Source ¹ (Ranges Locked)	(0 to 330) μA (0 to 3.3) mA (0 to 33) mA (0 to 330) mA (0 to 1.1) A (1.1 to 3) A (0 to 11) A (11 to 20.5) A	0.15 mA/A + 20 nA 0.1 mA/A + 50 nA 0.1 mA/A + 0.26 μA 0.1 mA/A + 2.6 μA 0.2 mA/A + 40 μA 0.38 A/A + 40 μA 0.5 mA/A + 0.5 mA 1 mA/A + 0.75 mA	Multiproduct Calibrator (Ranges Locked)
DC Current – Measure ¹	Up to 10 μA (10 to 100) μA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A (1 to 10) A (10 to 30) A	67 $\mu\text{A}/\text{A} + 0.6 \text{pA}$ 7.9 $\mu\text{A}/\text{A} + 59.1 \text{pA}$ 1.3 $\mu\text{A}/\text{A} + 68 \text{pA}$ 19 $\mu\text{A}/\text{A} + 5.8 \text{nA}$ 72 $\mu\text{A}/\text{A} + 0.54 \mu\text{A}$ 0.25 mA/A + 18 μA 0.28 mA/A + 47 μA 0.91 mA/A + 6.3 mA	8.5 Digit Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source ^{1,2}	(1 to 33) mV (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz (33 to 330) mV (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz (0.33 to 3.3) V (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz (3.3 to 33) V (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (33 to 330) V 45 Hz to 1 kHz (1 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	0.8 μ V/mV + 6 μ V 0.15 μ V/mV + 6.1 μ V 0.2 μ V/mV + 6.1 μ V 1 μ V/mV + 6.1 μ V 3.5 μ V/mV + 12 μ V 8 μ V/mV + 50 μ V 0.3 μ V/mV + 8.1 μ V 0.15 μ V/mV + 8.1 μ V 0.16 μ V/mV + 8.1 μ V 0.35 μ V/mV + 8.1 μ V 0.8 μ V/mV + 32 μ V 2 μ V/mV + 70 μ V 0.3 mV/V + 50 μ V 0.15 mV/V + 60 μ V 0.19 mV/V + 60 μ V 0.3 mV/V + 50 μ V 0.7 mV/V + 0.13 mV 2.4 mV/V + 0.6 mV 3 mV/V + 0.65 mV 1.5 mV/V + 0.6 mV 2.4 mV/V + 0.6 mV 3.5 mV/V + 0.6 mV 9 mV/V + 1.6 mV 0.19 mV/V + 2.1 mV 0.2 mV/V + 6.1 mV 0.25 mV/V + 6.1 mV 0.3 mV/V + 6.1 mV 2 mV/V + 50 mV 0.3 mV/V + 10 mV 0.25 mV/V + 10 mV 0.3 mV/V + 10 mV	Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ^{1,2}	Up to 10 mV 1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (10 to 100) mV 1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz (2 to 4) MHz (4 to 8) MHz (8 to 10) MHz (0.1 to 10) V 1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz (2 to 4) MHz (4 to 8) MHz (8 to 10) MHz (10 to 100) V 1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (100 to 1 000) V 1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.4 μ V/V + 0.6 nV 0.48 μ V/V + 0.6 nV 0.49 μ V/V + 0.6 nV 3.1 μ V/V + 0.6 nV 10 μ V/V + 0.6 nV 20 μ V/V + 0.6 nV 59 μ V/V + 3.5 μ V 97 μ V/V + 3.9 μ V 0.21 mV/V + 2.8 μ V 0.3 mV/V + 28 μ V 1.5 mV/V + 89 μ V 11 mV/V + 93 μ V 2 mV 5.1 mV 9.4 mV 17 mV 81 μ V/V 0.13 mV/V 0.24 mV/V 0.58 mV/V 2.4 mV/V 11 mV/V + 0.1 mV 20 mV/V 50 mV/V 92 mV/V 0.16 V/V + 0.6 mV 97 μ V/V + 0.16 mV 0.11 mV/V + 0.13 mV 0.35 mV/V + 0.23 mV 0.65 mV/V + 0.67 mV 4.4 mV/V + 20 mV 17 mV/V + 56 mV 0.14 mV/V + 4.5 mV 0.14 mV/V + 2.3 mV 0.25 mV/V + 1.7 mV 0.7 mV/V + 5.6 mV	8.5 Digit Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ^{1,2}	(29 to 330) 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 3.3) 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 33) 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 330) 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 (0.33 to 1.1) A (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (1.1 to 3) A (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (3 to 11) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	2 mA/A + 0.1 μ A 1.5 mA/A + 0.1 μ A 1.3 mA/A + 0.1 μ A 3 mA/A + 0.2 μ A 8 mA/A + 0.2 μ A 16 mA/A + 0.4 μ A 2 mA/A + 0.15 μ A 1.3 mA/A + 0.15 μ A 1 mA/A + 0.15 μ A 2 mA/A + 0.2 μ A 5 mA/A + 0.3 μ A 10 mA/A + 0.6 μ A 1.8 mA/A + 2 μ A 0.9 mA/A + 2 μ A 0.4 mA/A + 2 μ A 0.8 mA/A + 2 μ A 2 mA/A + 3 μ A 4 mA/A + 4 μ A 1.8 mA/A + 20 μ A 0.9 mA/A + 20 μ A 0.4 mA/A + 20 μ A 1 mA/A + 50 μ A 2 mA/A + 0.1 mA 4 mA/A + 0.2 mA 1.8 mA/A + 0.1 mA 0.5 mA/A + 0.1 mA 6 mA/A + 1 mA 25 mA/A + 5 mA 1.8 mA/A + 0.1 mA 0.6 mA/A + 0.1 mA 6 mA/A + 1 mA 25 mA/A + 5 mA 0.6 mA/A + 2 mA 1 mA/A + 2 mA 30 mA/A + 2 mA	Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ^{1,2}	(11 to 20.5) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	1.2 mA/A + 5 mA 1.5 mA/A + 5 mA 30 mA/A + 5 mA	Multiproduct Calibrator
AC Current – Measure ^{1,2}	(1 to 10) μ A 1 Hz to 10 kHz (10 to 30) kHz (10 to 100) μ A 1 Hz to 2 kHz 10 μ A to 1 mA (2 to 10) kHz 10 μ A to 10 mA (10 to 30) kHz (0.1 to 100) mA 1 Hz to 2 kHz (1 to 100) mA (2 to 10) kHz (10 to 100) mA (10 to 30) kHz (0.1 to 1) A 1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (1 to 10) A 10 Hz to 2 kHz (10 to 30) A 10 Hz to 2 kHz (2 to 10) kHz	2.3 nA/ μ A 2.3 nA/ μ A 0.11 nA/ μ A + 22 nA 0.56 nA/ μ A + 17 nA 0.8 nA/ μ A + 16 nA 0.33 nA/ μ A + 1 nA 0.56 μ A/mA + 10 nA 72 nA/mA + 0.54 μ A 0.4 mA/A + 7.8 μ A 0.65 mA/A + 9 μ A 0.9 mA/A + 11 μ A 0.9 mA/A + 0.26 mA 2 mA/A + 11 mA 1.4 mA/A + 5.3 mA	8.5 Digit Multimeter
Resistance – Source ¹ (Simulation)	Up to 11 Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω (0.33 to 1.1) k Ω (1.1 to 3.3) k Ω (3.3 to 11) k Ω (11 to 33) k Ω (33 to 110) k Ω (110 to 330) k Ω	40 μ Ω / Ω + 1 m Ω 30 μ Ω / Ω + 1.5 m Ω 28 μ Ω / Ω + 1.4 m Ω 28 μ Ω / Ω + 2 m Ω 28 μ Ω / Ω + 2 m Ω 28 μ Ω / Ω + 20 m Ω 28 μ Ω / Ω + 20.2 m Ω 28 μ Ω / Ω + 0.2 Ω 28 μ Ω / Ω + 0.2 Ω 32 μ Ω / Ω + 2 Ω	Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment	
Resistance – Source ¹ (Simulation)	(0.33 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 1 100) MΩ	32 µΩ/Ω + 2 Ω 60 µΩ/Ω + 30 Ω 0.13 mΩ/Ω + 50.2 Ω 0.25 mΩ/Ω + 2.5 kΩ 500 µΩ/Ω + 3 kΩ 3 mΩ/Ω + 0.1 MΩ 15 mΩ/Ω + 0.5 MΩ	Multiproduct Calibrator	
Resistance – Measure ¹²	(1 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 (0.1 to 1) GΩ	1.3 mΩ/Ω + 1.3 mΩ 9.5 µΩ/Ω + 20 mΩ 9.6 µΩ/Ω + 11.1 mΩ 9.7 µΩ/Ω + 0.11 mΩ 9.8 µΩ/Ω + 1.11 mΩ 12 µΩ/Ω + 0.2 Ω 0.13 mΩ/Ω + 0.12 kΩ 0.23 mΩ/Ω + 1.2 kΩ 2.5 mΩ/Ω + 0.23 mΩ	8.5 Digit Multimeter	
Capacitance – Source ² (Simulation)	10 Hz to 10 kHz 10 Hz to 10 kHz 10 Hz to 3 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 (0 to 50) Hz (0 to 20) Hz (0 to 6) Hz (0 to 2) Hz (0 to 0.6) Hz (0 to 0.2) Hz	(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) µF (1.1 to 3.3) µF (3.3 to 11) µF (11 to 33) µF (33 to 110) µF (110 to 330) µF (0.33 to 1.1) mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF	5 pF/pF + 10 pF 5 pF/pF + 10 pF 5 pF/pF + 10 pF 2.5 pF/nF + 10 pF 2.5 pF/nF + 0.1 nF 2.5 pF/nF + 0.1 nF 2.5 pF/nF + 0.3 nF 2.5 nF/µF + 1 nF 2.5 nF/µF + 3 nF 2.5 nF/µF + 10 nF 4 nF/µF + 30 nF 4.5 nF/µF + 0.1 µF 4.5 nF/µF + 0.3 µF 4.5 µF/mF + 1 µF 4.5 µF/mF + 3 µF 4.5 µF/mF + 10 µF 7.5 µF/mF + 30 µF 11 µF/mF + 0.1 mF	Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Measure ^{1,2}	(1 to 10) nF (10 to 100) nF (0.1 to 1) μ F (1 to 10) μ F (10 to 100) μ F (0.1 to 1) mF (1 to 10) mF (10 to 100) mF	8.1 pF/nF + 2.1 pF 0.54 pF/nF + 4.7 pF 0.51 pF/ μ F + 8.3 pF 0.52 pF/ μ F + 4.5 pF 0.73 nF/ μ F + 2.2 nF 0.72 nF/mF + 0.22 nF 0.8 μ F/mF + 0.11 μ F 1 μ F/mF + 0.2 μ F	8.5 Digit Multimeter
Electrical Simulation of RTD Indicating Devices – Source ^{1,2}	Pt 385, 100 Ω (-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C Pt 3926, 100 Ω (-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C Pt 3916, 100 Ω (-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C Pt 385, 200 Ω (-200 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.05 °C 0.07 °C 0.09 °C 0.1 °C 0.12 °C 0.23 °C 0.05 °C 0.07 °C 0.09 °C 0.1 °C 0.12 °C 0.25 °C 0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.08 °C 0.09 °C 0.1 °C 0.23 °C 0.04 °C 0.05 °C 0.12 °C 0.13 °C 0.14 °C 0.16 °C	Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of RTD Indicating Devices – Source ^{1,2}	Pt 385, 500 Ω (-200 to -80) °C (-80 to 100) °C (100 to 260) °C (260 to 400) °C (400 to 600) °C (600 to 630) °C Pt 385, 1 kΩ (-200 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 600) °C (600 to 630) °C	0.04 °C 0.05 °C 0.06 °C 0.08 °C 0.09 °C 0.11 °C 0.03 °C 0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.23 °C	Multiproduct Calibrator
Electrical Simulation of Thermocouple Indicating Devices – Source/Measure ^{1,2}	Type B (600 to 800) °C (800 to 1 000) °C (1 000 to 1 550) °C (1 550 to 1 820) °C Type C (0 to 150) °C (150 to 650) °C (650 to 1 000) °C (1 000 to 1 800) °C (1 800 to 2 316) °C Type E (-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (650 to 650) °C (650 to 1 000) °C Type J (-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1 200) °C	0.44 °C 0.34 °C 0.3 °C 0.33 °C 0.3 °C 0.26 °C 0.31 °C 0.5 °C 0.84 °C 0.5 °C 0.16 °C 0.14 °C 0.16 °C 0.21 °C 0.27 °C 0.16 °C 0.14 °C 0.17 °C 0.23 °C	Multiproduct Calibrator

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 ^{1,2}	Type K (-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1 000) °C (1 000 to 1 372) °C Type L (-200 to -100) °C (-100 to 800) °C (800 to 900) °C Type N (-200 to -100) °C (-100 to -25) °C (25 to 120) °C (120 to 410) °C (410 to 1 300) °C Type R (0 to 250) °C (250 to 400) °C (400 to 1 000) °C (1 000 to 1 767) °C Type S (0 to 250) °C (250 to 1 000) °C (1 000 to 1 400) °C (1 400 to 1 767) °C Type T (-250 to 150) °C (150 to 0) °C (0 to 120) °C (120 to 400) °C Type U (-200 to 0) °C (0 to 600) °C	0.33 °C 0.18 °C 0.16 °C 0.26 °C 0.4 °C 0.37 °C 0.26 °C 0.17 °C 0.4 °C 0.22 °C 0.19 °C 0.18 °C 0.27 °C 0.57 °C 0.35 °C 0.33 °C 0.4 °C 0.47 °C 0.36 °C 0.37 °C 0.34 °C 0.63 °C 0.24 °C 0.16 °C 0.14 °C 0.56 °C 0.27 °C	Multiproduct Calibrator

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Calipers ^{1,3} (Outside, Inside, Depth, Step)	Up to 6 in	$(290 + 0.62L) \mu\text{in}$	Gage Blocks

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Outside Micrometers ^{1,3}	Up to 1 in	(29 + 0.2L) μ in	Gage Blocks
Dial/Digital Indicators ^{1,3}	Up to 1 in	(58 + 0.14L) μ in	Gage Blocks

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pressure Devices ¹	(0 to 2.9) psig (2.9 to 14.5) psig (14.5 to 290) psig (290 to 1 015) psig	0.005 7 % of reading + 0.000 2 psi 0.005 5 % of reading + 0.000 4 psi 0.004 2 % of reading + 0.012 psi 0.006 % of reading + 0.027 psi	Pressure Controller/Calibrator with Modules
Absolute Pressure Devices	Up to 150 psia	0.024 % of reading + 0.036 psi	Pressure Controller
Barometric Pressure – Measure	(11.5 to 17.5) psia	0.003 4 psi	Pressure Controller
Vacuum Devices ¹	(-13.5 to 0) psi	0.012 psi	Pressure Controller/Calibrator with Modules
Analytical Balances ¹	(1 to 500) mg (0.5 to 5) g (5 to 10) g (10 to 20) g (20 to 50) g (50 to 100) g (100 to 500) g (500 to 1 000) g (1 000 to 2 000) g (2 000 to 4 000) g (4 000 to 5 000) g (5 000 to 10 000) g	11 μ g 40 μ g 58 μ g 86 μ g 0.14 mg 0.29 mg 0.58 mg 1.4 mg 2.9 mg 8.2 mg 13.9 mg 16.4 mg	ASTM E617 Class 1 weights and internal calibration procedure CP-500-0001 utilized in the calibration of the weighing system.
Mass Determination	(0.1 to 220) g (220 to 2 200) g (2 200 to 10 000) g	1 mg 11 mg 0.1 g	Class 1 Weights, Electronic Analytical Balances

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pipettes	(0.2 to 2) μl 10 μl 20 μl 100 μl 200 μl 1 000 μl 5 000 μl 10 000 μl	8.5 nl 15 nl 21 nl 84 nl 0.3 μl 1.2 μl 5.8 μl 12 μl	Pipette Calibrator
Mass Flow – Gas	(500 to 5 000) sccm (5 000 to 50 000) sccm (50 to 500) slpm	0.25 % of reading + 0.052 sccm 0.23 % of reading + 1.2 sccm 0.4 % of reading + 0.003 slpm	MesaLab DryCal Primary Volumetric Piston Prover System
Mass Flow – Gas	(0.1 to 1) slpm	0.12 % of reading + 0.000 02 slpm	Fluke molBox 1, Fluke molBloc-L-1 Laminar Flow Element
Mass Flow – Gas	(1 to 30) slpm	0.13 % of reading	Fluke molBox 1, Fluke molBloc-L-30 Laminar Flow Element
Mass Flow – Gas	(30 to 300) slpm	0.13 % of reading	Fluke molBox 1, Fluke molBloc-S-300 Sonic Flow Element
Torque Measuring Instruments ¹	(5 to 50) lbf·in (50 to 400) lbf·in (400 to 1 000) lbf·in (80 to 250) lbf·ft	0.29 % of reading + 0.011 lbf·in 0.13 % of reading + 1.4 lbf·in 0.29 % of reading + 0.29 lbf·in 0.31 % of reading + 0.002 lbf·ft	Torque Calibration System

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Humidity – Source/Measure	(5 to 95) %RH	0.32 % of reading + 1.3 %RH	Comparison to Temperature/Humidity Transmitter.
Temperature – Source	(-25 to 50) °C (50 to 140) °C (140 to 150) °C	0.037 °C 0.042 °C 0.058 °C	Portable Calibration Bath, Dry-well Calibrator, Temperature Indicator w/RTD
Temperature – Measure ¹	(-40 to 50) °C (50 to 150) °C	0.026 °C 0.033 °C	Temperature Indicator w/RTD

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Infrared Thermometers ¹	-15 °C	1.1 °C	Blackbody Source (Flat Plate) $\varepsilon = (0.9 \text{ to } 1)$, $\lambda = (8 \text{ to } 14) \mu\text{m}$
	0 °C	1.1 °C	
	50 °C	1.2 °C	
	100 °C	1.2 °C	
	120 °C	1.2 °C	

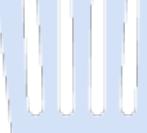
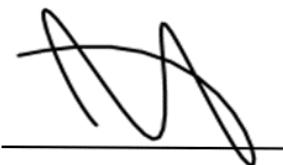
Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source ^{1,2}	10 mHz to 120 Hz	5.8 mHz	Multiproduct Calibrator
	120 Hz to 1.2 kHz	57.7 mHz	
	(1.2 to 12) kHz	0.58 Hz	
	(12 to 120) kHz	5.8 Hz	
	120 kHz to 1.2 MHz	57.8 Hz	
	(1.2 to 2) MHz	0.6 kHz	
Frequency – Measure ¹	Up to 10 Hz	12 µHz	8.5 Digit Multimeter
	10 Hz to 1 kHz	1.2 µHz/Hz	
	(1 to 10) kHz	0.12 mHz/kHz	
	(10 to 100) kHz	1.2 mHz/kHz	
	100 kHz to 1 MHz	12 mHz/MHz	
	(1 to 10) MHz	0.12 Hz/MHz	
Stopwatches/Timers ¹	(10 to 100) MHz	1.2 Hz/MHz	Timometer
	Up to 24 hr	35 ms/24 hr	

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. Uncertainty budget does not contain the Repeatability contributor for the DUT. Repeatability will be added to the Measurement Uncertainty at time of calibration.
3. L = length in inches.
4. 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 (MU) at the time of calibration.
5. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2949.



Jason Stine, Vice President