



CERTIFICATE OF ACCREDITATION

ANSI-ASQ National Accreditation Board

500 Montgomery Street, Suite 625, Alexandria, VA 22314, 877-344-3044

This is to certify that

E2b Calibration, LLC

521 Fifth Avenue

Chardon, OH 44024

has been assessed by ANAB
and meets the requirements of international standard

ISO/IEC 17025:2005

and national standard

ANSI/NCSL Z540-1-1994 (R2002)

while demonstrating technical competence in the field of

CALIBRATION

Refer to the accompanying Scope of Accreditation for information regarding the types of calibrations to which this accreditation applies.

AC-1287

Certificate Number


ANAB Approval

Certificate Valid: 03/16/2018-02/23/2019
Version No. 006 Issued: 03/16/2018



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. 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 17025:2005
AND ANSI/NCSL Z540-1-1994 (R2002)**

E2b Calibration, LLC

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CALIBRATION

Valid to: **February 23, 2019**

Certificate Number: **AC-1287**

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 (10 to 100) V 100 V to 1 kV | 1 μ V 8 μ V 75 μ V 1.3 mV 13 mV | Wavetek 1281 Multimeter |
| | (1 to 60) kV | 87 V | Ross VD60 Voltage Divider, HP3457A Multimeter |
| DC Voltage - Source ¹ | Up to 330 mV 330 mV to 3.3 V (3.3 to 33) V (33 to 330) V 330 V to 1 kV | 20 μ V/V + 1 μ V 11 μ V/V + 2 μ V 12 μ V/V + 20 μ V 18 μ V/V + 0.15 mV 18 μ V/V + 1.5 mV | Fluke 5520A Multiproduct Calibrator |
| DC Current - Measure ¹ | Up to 100 μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A | 2.4 μ A 2.5 μ A 3.6 μ A 19 μ A 0.28 mA | Wavetek 1281 Multimeter |
| | (1 to 11) A (11 A to 20.5) A | 2.1 mA 4.3 mA | ISOTec Shunt |



Electrical – DC/Low Frequency

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|-----------------------------------|--|--|---|
| DC Current – Source ¹ | Up to 330 μ A 330 μ A to 3.3 mA (3.3 to 33) mA (33 to 330) mA 330 mA to 1.09 A (1.1 to 10.9) A (10.9 to 20.5) A | 0.15 mA/A + 20 nA 0.1 mA/A + 50 nA 0.1 mA/A + 0.25 μ A 0.1 mA/A + 2.5 μ A 0.2 mA/A + 40 μ A 0.5 mA/A + 0.5 mA 1 mA/A + 0.75 mA | Fluke 5520A Multiproduct Calibrator |
| AC Voltage – Measure ¹ | Up to 100 mV (1 to 10) Hz (10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz | 51 μ V 51 μ V 30 μ V 30 μ V 32 μ V 58 μ V 0.15 mV | Wavetek 1281 Multimeter |
| | 100 mV to 100 V (45 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz 100 V to 1 kV 45 Hz to 10 kHz | 3.3 mV 7.6 mV 7.6 mV 7.7 mV 61 mV 20 mV | |
| | (1 to 42) kV 60Hz | 0.26 kV | Ross VD60 Voltage Divider, HP3457A Multimeter |
| AC Voltage - Source ¹ | Up 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 | 0.8 mV/V + 6 μ V 0.15 mV/V + 6 μ V 0.2 mV/V + 6 μ V 1 mV/V + 6 μ V 3.5 mV/V + 12 μ V 8 mV/V + 50 μ V | Fluke 5520A Multiproduct Calibrator |



Electrical – DC/Low Frequency

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|----------------------------------|--------------------|---|--|
| AC Voltage - Source ¹ | (33 to 330) mV | | Fluke 5520A Multiproduct Calibrator |
| | (10 to 45) Hz | 0.3 mV/V + 8 μV | |
| | 45 Hz to 10 kHz | 0.15 mV/V + 8 μV | |
| | (10 to 20) kHz | 0.16 mV/V + 8 μV | |
| | (20 to 50) kHz | 0.35 mV/V + 8 μV | |
| | (50 to 100) kHz | 0.8 mV/V + 32 μV | |
| | (100 to 500) kHz | 2 mV/V + 70 μV | |
| | 330 mV to 3.3 V | | |
| | (10 to 45) Hz | 0.3 mV/V + 50 μV | |
| | 45 Hz to 10 kHz | 0.15 mV/V + 60 μV | |
| | (10 to 20) kHz | 0.19 mV/V + 60 μV | |
| | (20 to 50) kHz | 0.3 mV/V + 50 μV | |
| | (50 to 100) kHz | 0.7 mV/V + 0.13 mV | |
| | (100 to 500) kHz | 2.4 mV/V + 0.6 mV | |
| | (3.3 to 33) V | | |
| | (10 to 45) Hz | 0.3 mV/V + 0.65 mV | |
| | 45 Hz to 10 kHz | 1.5 mV/V + 0.6 mV | |
| | (10 to 20) kHz | 0.24 mV/V + 0.6 mV | |
| (20 to 50) kHz | 0.35 mV/V + 0.6 mV | | |
| (50 to 100) kHz | 0.9 mV/V + 1.6 mV | | |
| (33 to 330) V | | | |
| 45 Hz to 1 kHz | 0.19 mV/V + 2 mV | | |
| (1 to 10) kHz | 0.2 mV/V + 6 mV | | |
| (10 to 20) kHz | 0.25 mV/V + 6 mV | | |
| (20 to 50) kHz | 0.3 mV/V + 6 mV | | |
| (50 to 100) kHz | 2 mV/V + 50 mV | | |
| 330 V to 1.02 kV | | | |
| 45 Hz to 1 kHz | 0.3 mV/V + 10 mV | | |
| (1 to 5) kHz | 0.25 mV/V + 10 mV | | |
| (5 to 10) kHz | 0.3 mV/V + 10 mV | | |
| AC Current - Source ¹ | (29 to 330) μA | | Fluke 5520A Multiproduct Calibrator |
| | (10 to 20) Hz | 2 mA/A + 0.1 μA | |
| | (20 to 45) Hz | 1.5 mA/A + 0.1 μA | |
| | 45 Hz to 1 kHz | 1.3 mA/A + 0.1 μA | |
| | (1 to 5) kHz | 3 mA/A + 0.15 μA | |
| | (5 to 10) kHz | 8 mA/A + 0.2 μA | |
| (10 to 30) kHz | 16 mA/A + 0.4 μA | | |



Electrical – DC/Low Frequency

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|----------------------------------|--|---|--|
| AC Current - Source ¹ | 330 μ A to 3.3 mA (10 to 20) Hz | 2 mA/A + 0.15 μ A | Fluke 5520A Multiproduct Calibrator |
| | (20 to 45) Hz | 1.3 mA/A + 0.1 μ A | |
| | 45 Hz to 1 kHz (1 to 5) kHz | 1 mA/A + 0.15 μ A | |
| | (5 to 10) kHz | 2 mA/A + 0.2 μ A | |
| | (10 to 30) kHz | 5 mA/A + 0.3 μ A | |
| | (3.3 to 33) mA (10 to 20) Hz | 10 mA/A + 0.6 μ A | |
| | (20 to 45) Hz | 1.8 mA/A + 2 μ A | |
| | 45 Hz to 1 kHz (1 to 5) kHz | 0.9 mA/A + 2 μ A | |
| | (5 to 10) kHz | 0.4 mA/A + 2 μ A | |
| | (10 to 30) kHz | 0.8 mA/A + 2 μ A | |
| | (33 to 330) mA (10 to 20) Hz | 2 mA/A + 3 μ A | |
| | (20 to 45) Hz | 4 mA/A + 4 μ A | |
| | 45 Hz to 1 kHz (1 to 5) kHz | 1.8 mA/A + 20 μ A | |
| | (5 to 10) kHz | 0.9 mA/A + 20 μ A | |
| | (10 to 30) kHz | 0.4 mA/A + 20 μ A | |
| | 330 mA to 1.1 A (10 to 45) Hz | 1 mA/A + 50 μ A | |
| | 45 Hz to 1 kHz (1 to 5) kHz | 2 mA/A + 0.1 mA | |
| | (5 to 10) kHz | 4 mA/A + 0.2 mA | |
| | (1.1 to 3) A (10 to 45) Hz | 1.8 mA/A + 0.1 mA | |
| | 45 Hz to 1 kHz (1 to 5) kHz | 0.5 mA/A + 0.1 mA | |
| | (5 to 10) kHz | 6 mA/A + 1 mA | |
| | (3 to 11) A (45 to 100) Hz | 25 mA/A + 5 mA | |
| | 100 Hz to 1 kHz (1 to 5) kHz | 1.8 mA/A + 0.1 mA | |
| | (11 to 20.5) A (45 to 100) Hz | 0.6 mA/A + 0.1 mA | |
| | 100 Hz to 1 kHz (1 to 5) kHz | 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 | | |
| | 1.2 mA/A + 5 mA | | |
| | 1.5 mA/A + 5 mA | | |
| | 30 mA/A + 5 mA | | |

Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---|--|---|--|
| AC Current - Measure ¹ | Up to 100 μ A 10 Hz to 5 kHz | 1.1 μ A | Wavetek 1281 Multimeter |
| | 100 μ A to 1 mA 10 Hz to 5 kHz | 6 μ A | |
| | (1 to 10) mA 10 Hz to 5 kHz | 26 μ A | |
| | (10 to 100) mA 10 Hz to 5 kHz | 0.35 mA | |
| | 100 mA to 1 A 10 Hz to 1 kHz | 0.56 mA | |
| | (1 to 5) kHz | 0.72 A | |
| | (1.1 to 3) A (10 to 45) Hz (45 to 400) Hz | 0.13 A 0.13 A | |
| (3 to 11) A (45 to 100) Hz (100 to 400) Hz | 0.13 A 0.13 A | | |
| (11 to 20.5) A (45 to 100) Hz (100 to 400) Hz | 0.13 A 0.13 A | | |
| 50 μ H 1 000 μ H 5 H | 0.32 μ H 2 μ H 0.014 H | GenRad Fixed Inductors | |
| 100 μ H to 1 mH (1 to 10) mH (10 to 100) mH 100 mH to 1 H (1 to 10) H | 0.20 nH 2.4 μ H 2.4 μ H 0.24 mH 2.4 mH | | RLC Bridge GenRad 1689 |
| Up to 1 nF (1 to 10) nF (10 to 100) nF 100 nF to 1 μ F (1 to 1.111) μ F | 0.2 pF 2.4 pF 24 pF 0.24 nF 0.29 nF | RLC Bridge GenRad 1689 | |
| 100 pF to 1 nF (1 to 10) nF (10 to 100) nF 100 nF to 1 μ F | 1.3 pF 0.013 nF 0.14 nF 1.3 nF | | 1423A Decade Box |



Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|-------------------------------------|-------------------|---|--|
| Capacitance - Source | | | |
| 10 Hz to 10 kHz | (190 to 400) pF | 5 mF/F + 0.01 nF | Fluke 5520A Multiproduct Calibrator |
| 10 Hz to 10 kHz | 400 pF to 1.1 nF | 5 mF/F + 0.01 nF | |
| 10 Hz to 3 kHz | (1.1 to 3.3) nF | 5 mF/F + 0.01 nF | |
| 10 Hz to 1 kHz | (3.3 to 11) nF | 2.5 mF/F + 0.01 nF | |
| 10 Hz to 1 kHz | (11 to 33) nF | 2.5 mF/F + 0.1 nF | |
| 10 Hz to 1 kHz | (33 to 110) nF | 2.5 mF/F + 0.1 nF | |
| 10 Hz to 1 kHz | (110 to 330) nF | 2.5 mF/F + 0.3 nF | |
| (10 to 600) Hz | 330 nF to 1.1 μF | 2.5 mF/F + 1 nF | |
| (10 to 300) Hz | (1.1 to 3.3) μF | 2.5 mF/F + 3 nF | |
| (10 to 150) Hz | (3.3 to 11) μF | 2.5 mF/F + 10 nF | |
| (10 to 120) Hz | (11 to 33) μF | 2.5 mF/F + 30 nF | |
| (10 to 80) Hz | (33 to 110) μF | 4 mF/F + 0.1 μF | |
| (10 to 50) Hz | (110 to 330) μF | 4.5 mF/F + 0.3 μF | |
| (10 to 20) Hz | 330 μF to 1.1 mF | 4.5 mF/F + 1 μF | |
| (0 to 6) Hz | (1.1 to 3.3) mF | 4.5 mF/F + 3 μF | |
| (0 to 2) Hz | (3.3 to 11) mF | 4.5 mF/F + 10 μF | |
| (0 to 0.6) Hz | (11 to 33) mF | 7.5 mF/F + 30 μF | |
| (0 to 0.2) Hz | (33 to 110) mF | 11 mF/F + 0.1 mF | |
| DC Resistance - Source ¹ | | | Fluke 5520A Multiproduct Calibrator |
| | Up to 11 Ω | 40 μΩ/Ω + 1 mΩ | |
| | (11 to 33) Ω | 30 μΩ/Ω + 1.5 mΩ | |
| | (33 to 110) Ω | 28 μΩ/Ω + 1.4 mΩ | |
| | (110 to 330) Ω | 28 μΩ/Ω + 2 mΩ | |
| | 330 Ω to 1.1 kΩ | 28 μΩ/Ω + 2 mΩ | |
| | (1.1 to 3.3) kΩ | 28 μΩ/Ω + 20 mΩ | |
| | (3.3 to 11) kΩ | 28 μΩ/Ω + 20 mΩ | |
| | (11 to 33) kΩ | 28 μΩ/Ω + 0.2 Ω | |
| | (33 to 110) kΩ | 28 μΩ/Ω + 0.2 Ω | |
| | (110 to 330) kΩ | 32 μΩ/Ω + 2 Ω | |
| | 330 kΩ to 1.1 MΩ | 32 μΩ/Ω + 2 Ω | |
| | (1.1 to 3.3) MΩ | 60 μΩ/Ω + 30 Ω | |
| | (3.3 to 11) MΩ | 0.13 mΩ/Ω + 50 Ω | |
| | (11 to 33) MΩ | 0.25 mΩ/Ω + 2.5 kΩ | |
| | (33 to 110) MΩ | 0.5 mΩ/Ω + 3 kΩ | |
| | (110 to 330) MΩ | 3 mΩ/Ω + 0.1 MΩ | |
| | 330 MHz to 1.1 GΩ | 15 mΩ/Ω + 0.5 MΩ | |



Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---|---|---|--|
| DC Resistance - Measure ¹ | Up to 10 Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ | 1.6 mΩ 4.4mΩ 29 mΩ 0.29 Ω 3 Ω 40 Ω 1.4 kΩ | Wavetek 1281 Multimeter |
| Oscilloscopes ^{1,2} Amplitude - DC 50 Ω 1 MΩ Amplitude - Square Wave 50 Ω 1 MΩ Leveled Sine Wave Relative to 50 kHz Amplitude Flatness Time Marker Rise Time | (-6.6 to 6.6) V (-130 to 130) V 1 mV to 6.6 V (p-p) 1 mV to 130 V (p-p) 50 kHz reference 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz 5 s to 50 ms 20 ms to 2 ns ≤ 300 ps | 6.5 mV/V + 40 μV 6 mV/V + 40 μV 6.5 mV/V + 40 μV 6.1 mV/V + 40 μV 21 mV/V + 0.3 mV 36 mV/V + 0.3 mV 40 mV/V + 0.3 mV 60 mV/V + 0.3 mV 16 mV/V + 0.1 mV 21 mV/V + 0.1 mV 40 mV/V + 0.1 mV (3 800 + 1 000t) μs/s 3.8 ms/s 3.8 ms/s | Fluke 5520A/SC600 Multiproduct Calibrator |
| Electrical Simulation of Thermocouple Indicators ¹ | Type B (600 to 800) °C (800 to 1 000) °C (1 000 to 1 550) °C (1 550 to 1 820) °C | 0.27 °C 0.21 °C 0.18 °C 0.2 °C | Fluke 5520A Multiproduct Calibrator |



Electrical – DC/Low Frequency

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|---|---------------------|---|--|
| Electrical Simulation of Thermocouple Indicators ¹ | Type C | | Fluke 5520A Multiproduct Calibrator |
| | (0 to 150) °C | 0.18 °C | |
| | (150 to 650) °C | 0.16 °C | |
| | (650 to 1 000) °C | 0.19 °C | |
| | (1 000 to 1 800) °C | 0.3 °C | |
| | (1 800 to 2 316) °C | 0.5 °C | |
| | Type E | | |
| | (-250 to -100) °C | 0.3 °C | |
| | (-100 to -25) °C | 0.1 °C | |
| | (-25 to 350) °C | 0.09 °C | |
| | (350 to 650) °C | 0.1 °C | |
| | (650 to 1 000) °C | 0.13 °C | |
| | Type J | | |
| | (-210 to -100) °C | 0.16 °C | |
| | (-100 to -30) °C | 0.1 °C | |
| | (-30 to 150) °C | 0.09 °C | |
| | (150 to 760) °C | 0.11 °C | |
| | (760 to 1 200) °C | 0.14 °C | |
| | Type K | | |
| | (-200 to -100) °C | 0.2 °C | |
| | (-100 to -25) °C | 0.11 °C | |
| | (-25 to 120) °C | 0.1 °C | |
| | (120 to 1 000) °C | 0.16 °C | |
| | (1 000 to 1 372) °C | 0.24 °C | |
| | Type L | | |
| | (-200 to -100) °C | 0.22 °C | |
| | (-100 to 800) °C | 0.16 °C | |
| | (800 to 900) °C | 0.11 °C | |
| Type N | | | |
| (-200 to -100) °C | 0.24 °C | | |
| (-100 to -25) °C | 0.13 °C | | |
| (-25 to 120) °C | 0.12 °C | | |
| (120 to 410) °C | 0.11 °C | | |
| (410 to 1 300) °C | 0.16 °C | | |
| Type R | | | |
| (0 to 250) °C | 0.34 °C | | |
| (250 to 400) °C | 0.21 °C | | |
| (400 to 1 000) °C | 0.2 °C | | |
| (1 000 to 1 767) °C | 0.24 °C | | |



Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---|---------------------|---|--|
| Electrical Simulation of Thermocouple Indicators ¹ | Type S | | Fluke 5520A Multiproduct Calibrator |
| | (0 to 250) °C | 0.28 °C | |
| | (250 to 1 000) °C | 0.22 °C | |
| | (1 000 to 1 400) °C | 0.22 °C | |
| | (1 400 to 1 767) °C | 0.28 °C | |
| | Type T | | |
| | (-250 to -150) °C | 0.38 °C | |
| | (-150 to 0) °C | 0.15 °C | |
| | (0 to 120) °C | 0.1 °C | |
| | (120 to 400) °C | 0.09 °C | |
| Type U | | | |
| (-200 to 0) °C | 0.34 °C | | |
| (0 to 600) °C | 0.16 °C | | |
| Phase Angle - Source ¹ | (0 to 360)° | | Fluke 5520A Multiproduct Calibrator |
| | (10 to 65) Hz | 0.17 ° | |
| | (65 to 500) Hz | 0.33 ° | |
| | 500 Hz to 1 kHz | 0.61 ° | |
| | (1 to 5) kHz | 3 ° | |
| | (5 to 10) kHz | 6 ° | |
| (10 to 30) kHz | 12 ° | | |

Electrical – RF/Microwave

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---|-----------------------|---|---|
| RF Power - Measure ¹ Up to 18 GHz | (-60 to +30) dBm | 0.23 dBm | Boonton 4200 Power Meter with Boonton 4200-4E and Boonton 4200-6E Sensors |
| Amplitude Modulation ¹ - Measure | (0 to 99) %Depth | | HP 8902A Measuring Receiver |
| | 150 kHz to 10 MHz | 2.4 %Depth | |
| Frequency Modulation ¹ - Measure | 10 MHz to 1.3 GHz | 1.2 %Depth | |
| | (0 to 99) %Deviation | | |
| Phase Modulation ¹ - Measure | 150 kHz to 10 MHz | 2.4 % of reading | |
| | 10 MHz to 1.3 GHz | 1.2 % of reading | |
| Phase Modulation ¹ - Measure | (0 to 99) % Deviation | | |
| | 150 kHz to 10 MHz | 3.6 % of reading | |
| | 10 MHz to 1.3 GHz | 3.6 % of reading | |



Electrical – RF/Microwave

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|---|--|---|
| Tuned RF Level Attenuation ¹ - Measure | 2.5 MHz to 1.3 GHz (-10 to 0) dBm (-40 to -10) dBm (-50 to -40) dBm (-80 to -50) dBm (-90 to -80) dBm (-110 to -90) dBm (-120 to -110) dBm | 0.02 dB 0.08 dB 0.14 dB 0.2 dB 0.26 dB 0.3 dB 0.4 dB | HP 8902A Measuring Receiver with HP 11722A Power Sensor |
| Harmonics - Measure ¹ | (-80 to 0) dB 30 Hz to 6.5 GHz | 1 dBm | HP 8561E Spectrum Analyzer |
| AM Distortion - Measure ¹ | (-80 to 0) dB 20 Hz to 20 kHz (20 to 100) kHz | 1.2 dB 2.4 dB | HP 8903B Audio Analyzer |
| FM Distortion - Measure ¹ | (-80 to 0) dB 20Hz to 20 kHz (20 to 100) kHz | 1.2 dB 2.4 dB | |

Length – Dimensional metrology

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|--|---|--|
| Calipers ^{1,2} | (0 to 4) in (4 to 24) in (24 to 60) in | (93 + 37L) μin (37 + 55L) μin (180 + 48L) μin | Gage Blocks and Length Standards |
| Micrometers ^{1,2} | (0 to 1) in (1-4) in (Up to 42) in | (77 + 17L) μin (51 + 41L) μin (620 + 37L) μin | |
| Dial Indicators ^{1,2} Resolution 0.000 05 in 0.001 in | Up to 1 in Up to 4 in | (74 + 44L) μin (1 400 + 87L) μin | |

Mass and Mass-Related

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---|--------------------|---|--|
| Pressure Gages & Transducers ¹ | (0 to 300) psia | 0.015 psi | Druck DPI-145 Pressure indicator |
| | (50 to 15 000) psi | 0.03 % of reading | TD-4000N Deadweight Tester |



Mass and Mass-Related

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment | |
|---|--|---|---|-----------------|
| Vacuum ¹ | (0.5 to 19) psia | 0.012 psi | Druck DPI-145 Pressure indicator | |
| Mass Flow ¹ | (5 to 500) SCCM | 0.3 % of reading | ML-800-10 Flow Cell ML-800-45 Flow Cell | |
| | (500 to 50 000) SCCM | 0.3 % of reading | | |
| | (0 to 7) SCFM (7 to 35) SCFM (35 to 90) SCFM | 0.61 % of reading 0.65 % of reading 0.67 % of reading | Cox 16-064 Sonic Nozzle Cox 16-121 Sonic Nozzle Cox 16-228 Sonic Nozzle | |
| Pipettes | Up to 10 uL | 0.06 µL | A&D 4212B-101 Balance and Software | |
| | (10 to 20) uL | 0.08 µL | | |
| | (20 to 50) uL | 0.1 µL | | |
| | (50 to 100) uL | 0.1 µL | | |
| | (100 to 200) uL | 0.17 µL | | |
| | (200 to 500) uL (500 to 1 000) uL | 0.42 µL 0.53 µL | | |
| Torque Transducers ¹ | (0 to 100) lbf·ft | 0.06 % of reading | F-Class Weights, 10 in Torque Arm | |
| | (100 to 1 000) lbf·ft | 0.6 % of reading | F-Class Weights, 4 ft Torque Arm | |
| Torque Tools ¹ | (0 to 90) lbf·in | 0.61 % of reading | HIOS HP-100 Torque Tester | |
| | (90 to 350) lbf·in | 0.79 % of reading | Norbar Pro Test – 350 lbf·in Norbar Pro Test – 110 lbf·ft Norbar Pro Test – 1 100 lbf·ft | |
| | (30 to 60) lbf·ft | 0.8 % of reading | | |
| | (60 to 110) lbf·ft (110 to 1 100) lbf·ft | 0.6 % of reading 0.32 % of reading | | |
| Force ¹ - Compression & Tension | (0 to 50) lbf | 0.01 lbf | Interface Load Cell - 50 lbf Interface Load Cell - 1 000 lbf Interface Load Cell - 10 000 lbf Interface Load Cell - 50 000 lbf | |
| | (50 to 1 000) lbf | 0.31 lbf | | |
| | (1 000 to 10 000) lbf | 2.5 lbf | | |
| | (10 000 to 50 000) lbf | 13 lbf | | |
| Laboratory Balances ¹ | 0.000 1 mg | Up to 2 g | 0.002 mg | Class 1 Weights |
| | 0.001 mg | Up to 20 g | 0.01 mg | |
| | 0.01 mg | Up to 100 g | 0.05 mg | |
| | 1 mg | Up to 1 000 g | 1.7 mg | |
| | 1 mg | Up to 3 000 g | 2.2 mg | |
| | 0.01 g | Up to 5 000 g | 16 mg | |
| | 0.01 g | Up to 25 000 g | 25 mg | |
| | 0.1 g | Up to 25 000 g | 160 mg | |
| | 0.1 g | Up to 40 000 g | 190 mg | |
| | Scales ¹ | Resolution 0.05 lb | Up to 250 lb | |
| 0.1 lb | | Up to 600 lb | 0.18 g | |



Thermodynamic

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|------------------------------------|--|--|---|
| Humidity - Measure ¹ | (0 to 90) %RH (90 to 100) %RH | 1.3 %RH 2.2 %RH | Vaisala HMP-363 Transmitter |
| Humidity - Source ¹ | 11.3 %RH 32.9 %RH 75.4 %RH 96.7 %RH | 1.3 %RH 1.3 %RH 1.3 %RH 2.2 %RH | Vaisala HMP-363 Transmitter, Saturated Salt Solutions |
| Temperature - Measure ¹ | (-200 to 0) °C (0 to 200) °C (200 to 600) °C | 28 mK (0.028 °C) 36 mK (0.036 °C) 56 mK (0.056 °C) | Fluke 5628 SPRT, HP 3457A Multimeter |
| Temperature - Source ¹ | (0 to 125) °C | 36 mK (0.036 °C) | Ametek ETC-125 Dryblock, Fluke 5628 SPRT, HP 3457A Multimeter |

Time and Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|----------------------------------|---------------------------------------|---|---|
| Frequency - Source ¹ | (0 to 1.056) GHz | 7 parts in 10 ¹⁰ of output + 1 Hz | Fluke 6080A Signal Generator Locked to Datum LPRO Rubidium Freq Std |
| Frequency - Measure ¹ | (0 to 225) MHz 225 MHz to 26.5 GHz | 7 parts in 10 ¹⁰ of reading + 1 Hz | Agilent 53131A Counter HP 5348A Counter |

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. L = length in inches, t = time in seconds.
3. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-1287.

Vice President

