



CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Transcat – Cincinnati
11402 Reading Road
Cincinnati, OH 45241

Fulfills the requirements of

ISO/IEC 17025:2017

and national standards

ANSI/NCSL Z540-1-1994 (R2002) and
ANSI/NCSL Z540.3-2006 (R2013)

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.

Jason Stine, Vice President
Expiry Date: 07 September 2025
Certificate Number: L2181-1



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

and

ANSI/NCSL Z540-1-1994 (R2002)

ANSI/NCSL Z540.3-2006 (R2013)

Transcat – Cincinnati

11402 Reading Road

Cincinnati, OH 45241

Jim Dull 513-832-6274

CALIBRATION

Valid to: **September 7, 2025**

Certificate Number: **L2181-1**

Acoustics and Vibration

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---------------------------|----------------------|---|--|
| Accelerometer Sensitivity | (0 to 5 000) mV/g | | Comparison to Master Accelerometer per ISO 16063-21-2003 |
| | (10 to 99) Hz | 1.7 % of reading | |
| | 100 Hz | 1.4 % of reading | |
| | (101 to 920) Hz | 1.6 % of reading | |
| | (921 to 5 000) Hz | 1.9 % of reading | |
| | (5 001 to 10 000) Hz | 2.3 % of reading | |

Chemical Quantities

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|----------------------------------|--------------|---|--|
| pH Meters ⁷ | 4 pH | 0.023 pH | Compared to Accredited Solutions |
| | 7 pH | 0.023 pH | |
| | 10 pH | 0.025 pH | |
| Conductivity Meters ⁷ | 1 µS/cm | 0.69 µS/cm | Compared to Accredited Solutions |
| | 10 µS/cm | 0.69 µS/cm | |
| | 100 µS/cm | 2.2 µS/cm | |
| | 1 000 µS/cm | 6.3 µS/cm | |
| | 10 000 µS/cm | 50.3 µS/cm | |



ANSI National Accreditation Board

Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|-------------------------------------|---|---|--|
| Capacitance – Source ^{1,3} | 1 kHz (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 100 Hz (0.33 to 1.1) μF (1.1 to 3.3) μF (3.3 to 11) μF (11 to 33) μF 50 Hz (33 to 110) μF (110 to 330) μF (330 to 1 100) μF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF | (0.002 + 0.004X) pF (0.013 + 0.006X) nF (0.012 + 0.006X) nF (0.015 + 0.003X) nF (0.12 + 0.003X) nF (0.12 + 0.003X) nF (0.34 + 0.003X) nF (0.001 + 0.003X) μF (0.001 + 0.003X) μF (0.003 4 + 0.003X) μF (0.012 + 0.003X) μF (0.031 + 0.005X) μF (0.12 + 0.006X) μF (0.35 + 0.005 3X) μF (1.2 + 0.005 3X) μF (0.004 + 0.005 3X) mF (0.012 + 0.005 2X) mF (0.034 + 0.008 7X) mF (0.11 + 0.013X) mF | Fluke 5520A Multiproduct Calibrator |
| Capacitance – Measure | (0.2 to 2) nF (2 to 20) nF (20 to 200) nF (0.2 to 2) μF (2 to 20) μF (20 to 200) μF (Up to 10) mF (10 to 50) mF | 0.9 % of reading + 23 pF 1.2 % of reading + 14 pF 0.9 % of reading + 27 pF 0.8 % of reading + 4 nF 0.9 % of reading + 0.6 nF 0.8 % of reading + 13 nF 1.3 % of reading + 10 nF 2.5 % of reading + 70 nF | Tenma 72-8150 Capacitance Meter |
| DC Current – Measure ^{1,3} | (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (100 to 1 000) mA (1 to 10) A (10 to 30) A | (0.000 014 + 0.000 003X) mA (0.006 + 0.000 3X) mA (0.008 4 + 0.000 03X) mA (0.013 + 0.000 2X) mA (0.000 4 + 0.000 5X) A (0.005 + 0.000 6X) A | Transmille 8081 Digital Multimeter |
| DC Current – Measure ^{1,3} | (30 to 1 000) A | (0.77 + 0.024X) A | Fluke 378 FC Clamp Meter |

Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|-------------------------------------|--|--|---|
| DC Current – Source ^{1,3} | Up to 3.3 mA (3.3 to 33) mA (33 to 330) mA (0.33 to 3) A (3 to 20.5) A | (0.000 06 + 0.000 8X) mA (0.004 + 0.000 09X) mA (0.006 + 0.000 1X) mA (0.000 04 + 0.000 5X) A (0.001 + 0.001 2X) A | Fluke 5520A Multiproduct Calibrator |
| DC Current – Source ¹ | (20.5 to 400) A (400 to 500) A | 0.58 % of reading + 0.62 A 0.57 % of reading + 0.65 A | Fluke 5520A Multiproduct Calibrator, Fluke 5500A Coil |
| AC Current – Measure ^{1,3} | Up to 100 µA (1 to 10) kHz (0.1 to 1) mA (1 to 10) kHz (1 to 10) mA (10 to 40) Hz 40 Hz to 1 kHz (1 to 10) kHz (0.01 to 1) A (10 to 40) Hz 40 Hz to 1 kHz (1 to 10) kHz (1 to 10) A (10 to 40) Hz 40 Hz to 1 kHz (1 to 10) kHz (10 to 30) A (10 to 40) Hz 40 Hz to 1 kHz | (0.094 + 0.000 7X) µA (0.000 2 + 0.000 4X) mA (0.003 5 + 0.000 9X) mA (0.003 5 + 0.000 9X) mA (0.002 8 + 0.0013X) mA (0.000 3 + 0.000 72X) A (0.000 2 + 0.000 5X) A (0.000 6 + 0.000 82X) A (0.004 7 + 0.000 94X) A (0.004 7 + 0.000 94X) A (0.014 + 0.001X) A (0.014 + 0.001X) A | Transmille 8081 Digital Multimeter |
| AC Current – Measure ^{1,3} | (30 to 1 000) A (45 to 65) Hz | (0.77 + 0.024X) A | Fluke 336 Clamp Meter |
| AC Current – Source ^{1,3} | Up to 0.33 mA (1 to 10) kHz (0.33 to 3.3) mA (1 to 10) kHz (3.3 to 33) mA (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz | (0.000 24 + 0.009 4X) mA (0.000 31 + 0.006X) mA (0.002 3 + 0.001 1X) mA (0.000 85 + 0.000 74X) mA (0.002 4 + 0.001X) mA (0.004 + 0.002 3X) mA (0.003 + 0.005X) mA | Fluke 5520A Multiproduct Calibrator |

Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|---|---|---|
| AC Current – Source ^{1,3} | (33 to 330) mA (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) A (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (3 to 20.5) A (45 to 65) Hz 65 Hz to 1 kHz (1 to 5) kHz | (0.024 + 0.001 1X) mA (0.022 + 0.000 5X) mA (0.063 + 0.001 2X) mA (0.12 + 0.002 3X) mA (0.22 + 0.005X) mA (0.000 14 + 0.002X) A (0.000 13 + 0.000 7X) A (0.001 2 + 0.007X) A (0.006 + 0.003 1X) A (0.006 + 0.002X) A (0.006 + 0.002X) A (0.006 4 + 0.035X) A | Fluke 5520A Multiproduct Calibrator |
| AC Current – Source ¹ | (20.5 to 500) A (45 to 100) Hz | 0.62 % of reading + 0.57 A | Fluke 5520A Multiproduct Calibrator, Fluke 5500A Coil |
| DC Power – Source ^{1,3} | Up to 336 W (360 to 3 059.9) W (3 059.9 to 20 910) W | (0.05 + 0.000 3X) W (0.001 5 + 0.000 4X) W (0.15 + 0.000 3X) W | Fluke 5520A Multiproduct Calibrator |
| AC Power – Source ^{1,3} PF = 1 | (10 to 45) Hz 3.3 mA to 3 A 0.11 μW to 99 W (45 to 65) Hz 3.3 mA to 20.5 A 0.11 mW to 20.91 kW (65 to 500) Hz 33 mA to 3 A 0.11 μW to 99 W 33 mA to 20.5 A 0.11 mW to 20.91 kW | 0.27 % of reading + 1 μW 0.24 % of reading + 0.9 μW 0.25 % of reading + 28 μW 0.22 % of reading + 0.25 mW | Fluke 5520A Multiproduct Calibrator |
| AC Power – Source ^{1,3} PF = 1 | 500 Hz to 1 kHz 33 mA to 20.5 A 0.11 μW to 20.91 kW | 0.25 % of reading + 27 μW | Fluke 5520A Multiproduct Calibrator |

Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|---|--|--|
| Resistance – Measure ^{1,3} | (0.000 5 to 5 000) mΩ Up to 1 Ω (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 | 0.06 % of reading + 1.8 μΩ 0.003 % of reading + 8 μΩ 0.002 % of reading + 4 μΩ 0.002 % of reading + 0.77 mΩ 0.001 % of reading + 5 mΩ 0.002 % of reading + 9 mΩ 0.002 % of reading + 93 mΩ 0.002 3 % of reading + 3 Ω 0.003 % of reading + 12 Ω | Transmille 8081 Digital Multimeter |
| Resistance – Measure ^{1,3} | (10 to 100) MΩ | 1.2 % of reading + 1.5 kΩ | Agilent 34401A Digital Multimeter |
| Resistance – Source ^{1,3} (Simulation) | Up to 11 Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω (0.33 to 1.1) kΩ (1.1 to 3.3) kΩ (3.3 to 11) kΩ (11 to 33) kΩ (33 to 110) kΩ (110 to 330) kΩ (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 | (0.001 2 + 0.000 05X) Ω (0.002 + 0.000 04X) Ω (0.001 6 + 0.000 04X) Ω (0.002 4 + 0.000 04X) Ω (0.000 023 + 0.000 04X) kΩ (0.000 02 + 0.000 04X) kΩ (0.000 03 + 0.000 04X) kΩ (0.000 3 + 0.000 04X) kΩ (0.000 3 + 0.000 04X) kΩ (0.002 5 + 0.000 04X) kΩ (0.000 002 + 0.000 04X) MΩ (0.000 04 + 0.000 07X) MΩ (0.000 06 + 0.000 2X) MΩ (0.000 7 + 0.001 2X) MΩ (0.006 4 + 0.006X) MΩ (0.005 5 + 0.006X) MΩ | Fluke 5520A Multiproduct Calibrator |
| Resistance – Source ^{1,3} (Fixed Simulation) | 500 μΩ 5 mΩ 50 mΩ 500 mΩ 5 Ω | (0.001 + 0.006X) mΩ (0.001 + 0.006X) mΩ (0.001 + 0.006X) mΩ (0.001 + 0.006X) mΩ (0.001 + 0.006X) mΩ | Fluke 5500A Multiproduct Calibrator, Agilent 34401A Digital Multimeter, Current Shunts |
| Electrical Simulation of RTD Indicators – Source ¹ | Pt 385, 100 Ω (-200 to 800) °C | 0.06 °C | Fluke 5500A Multiproduct Calibrator |
| DC Voltage – Measure ^{1,3} | Up to 1 V (1 to 10) V (10 to 100) V (100 to 1 000) V | (0.000 001 + 0.000 01X) V (0.000 007 + 0.000 006X) V (0.000 07 + 0.000 01X) V (0.001 1 + 0.000 011X) V | Transmille 8081 Multimeter |
| DC High Voltage – Measure ^{1,3} | (1 to 80) kV | 0.12 % of reading + 0.14 V | Ross Engineering HV Probe w/ Digital Multimeter |



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Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|--|---|---|
| DC Voltage – Source ^{1,3} | (0 to 330) mV (0.33 to 3.3) V (3.3 to 33) V (33 to 330) V (330 to 1 020) V | (0.001 2 + 0.000 006X) mV (0.000 001 + 0.000 006X) V (0.000 02 + 0.000 003X) V (0.000 13 + 0.000 003X) V (0.0006 + 0.000 004X) V | Fluke 5520A Multiproduct Calibrator |
| AC Voltage – Measure ^{1,3} | Up to 100 mV (10 to 40) Hz (40 to 200) Hz 200 Hz to 2 kHz (2 to 20) kHz (20 to 100) kHz (0.1 to 1) V (10 to 40) Hz (40 to 200) Hz 200 Hz to 1 kHz (1 to 2) kHz (2 to 20) kHz (20 to 100) kHz 100 kHz to 1 MHz (1 to 10) V (10 to 40) Hz (40 to 200) Hz 200 Hz to 1 kHz (1 to 2) kHz (2 to 20) kHz (20 to 100) kHz (10 to 100) V (10 to 40) Hz (40 to 200) Hz 200 Hz to 1 kHz (1 to 2) kHz (2 to 20) kHz (20 to 50) kHz (100 to 1 000) V (10 to 40) Hz (40 to 200) Hz 200 Hz to 2 kHz (2 to 10) kHz | (0.02 + 0.000 6X) mV (0.015 + 0.000 3X) mV (0.014 + 0.000 3X) mV (0.015 + 0.000 4X) mV (0.13 + 0.000 4X) mV (0.000 2 + 0.000 5X) V (0.000 07 + 0.000 25X) V (0.000 07 + 0.000 2X) V (0.000 07 + 0.000 2X) V (0.000 12 + 0.000 25X) V (0.000 6 + 0.000 7X) V (0.03 + 0.012X) V (0.002 + 0.000 5X) V (0.000 9 + 0.000 2X) V (0.000 8 + 0.000 2 X) V (0.000 8 + 0.000 2X) V (0.001 2 + 0.000 3X) V (0.006 + 0.000 8X) V (0.02 + 0.000 6X) V (0.01 + 0.000 3X) V (0.009 + 0.000 3X) V (0.009 + 0.000 3X) V (0.01 + 0.000 5X) V (0.06 + 0.001X) V (0.18 + 0.000 6X) V (0.1 + 0.000 3X) V (0.09 + 0.000 23X) V (0.12 + 0.000 4X) V | Transmille 8081 Digital Multimeter |
| AC High Voltage – Measure ^{1,3} | 60 Hz (1 to 80) kV | (0.01 + 0.012X) kV | Ross Engineering HV Probe w/ Digital Multimeter |



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Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|------------------------------------|-----------------------|---|--|
| AC Voltage – Source ^{1,3} | Up to 330 mV | | Fluke 5520A Multiproduct Calibrator |
| | (10 to 45) Hz | (0.007 + 0.001X) mV | |
| | 45 Hz to 10 kHz | (0.01 + 0.000 2X) mV | |
| | (10 to 20) kHz | (0.008 + 0.000 3X) mV | |
| | (20 to 50) kHz | (0.01 + 0.001 2X) mV | |
| | (50 to 100) kHz | (0.001 + 0.005X) mV | |
| | (100 to 500) kHz | (0.07 + 0.009 5X) mV | |
| | (0.33 to 3.3) V | | |
| | (10 to 45) Hz | (0.000 04 + 0.000 4X) V | |
| | 45 Hz to 10 kHz | (0.000 07 + 0.000 2X) V | |
| | (10 to 20) kHz | (0.000 08 + 0.000 23X) V | |
| | (20 to 50) kHz | (0.000 04 + 0.000 4X) V | |
| | (50 to 100) kHz | (0.000 2 + 0.000 8X) V | |
| | (100 to 500) kHz | (0.001 2 + 0.003X) V | |
| | (3.3 to 33) V | | |
| | (10 to 45) Hz | (0.000 6 + 0.000 4X) V | |
| | 45 Hz to 10 kHz | (0.000 7 + 0.000 2X) V | |
| | (10 to 20) kHz | (0.000 7 + 0.000 3X) V | |
| | (20 to 50) kHz | (0.000 8 + 0.000 4X) V | |
| | (50 to 100) kHz | (0.002 + 0.001X) V | |
| (33 to 330) V | | | |
| 45 Hz to 1 kHz | (0.003 + 0.000 3X) V | | |
| (1 to 10) kHz | (0.008 + 0.000 3X) V | | |
| (10 to 20) kHz | (0.007 + 0.000 3X) V | | |
| (20 to 50) kHz | (0.006 + 0.000 4X) V | | |
| (50 to 100) kHz | (0.064 + 0.002 3X) V | | |
| (330 to 1 000) V | | | |
| 45 Hz to 1 kHz | (0.022 + 0.000 34X) V | | |
| (1 to 5) kHz | (0.03 + 0.000 3X) V | | |
| (5 to 10) kHz | (0.01 + 0.000 4X) V | | |

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 E | | Fluke 5520A Multiproduct Calibrator |
| | (-250 to -100) °C | 0.58 °C | |
| | (-100 to -25) °C | 0.19 °C | |
| | (-25 to 350) °C | 0.17 °C | |
| | (350 to 650) °C | 0.19 °C | |
| | (650 to 1 000) °C | 0.25 °C | |
| | Type J | | |
| | (-210 to -30) °C | 0.32 °C | |
| | (-30 to 150) °C | 0.17 °C | |
| | (150 to 760) °C | 0.2 °C | |
| | (760 to 1 200) °C | 0.27 °C | |
| | Type K | | |
| | (-200 to -100) °C | 0.39 °C | |
| | (-100 to -25) °C | 0.21 °C | |
| | (-25 to 120) °C | 0.19 °C | |
| | (120 to 1 000) °C | 0.22 °C | |
| | (1 000 to 1 372) °C | 0.47 °C | |
| | Type N | | |
| | (-200 to -100) °C | 0.47 °C | |
| | (-100 to -25) °C | 0.26 °C | |
| | (-25 to 120) °C | 0.22 °C | |
| (120 to 410) °C | 0.21 °C | | |
| (410 to 1 300) °C | 0.32 °C | | |
| Type R | | | |
| (0 to 250) °C | 0.67 °C | | |
| (250 to 1 767) °C | 0.47 °C | | |
| Type S | | | |
| (0 to 250) °C | 0.55 °C | | |
| (250 to 1 400) °C | 0.44 °C | | |
| (1 400 to 1 767) °C | 0.54 °C | | |
| Type T | | | |
| (-250 to -150) °C | 0.73 °C | | |
| (-150 to 0) °C | 0.28 °C | | |
| (0 to 120) °C | 0.19 °C | | |
| (120 to 400) °C | 0.17 °C | | |
| Oscilloscopes – Time Base ¹ | (2 to 10) ns | 0.000 3 % of reading + 3 fs | Fluke 5500A-SC600 Multiproduct Calibrator |
| | 20 ns to 1 μs | 0.02 % of reading | |
| | (2 to 50) μs | 0.000 2 % of reading + 4 ps | |
| | (0.1 to 5 000) ms | 0.2 % of reading + 0.23 ms | |
| Oscilloscopes – Bandwidth ¹ | 50 kHz to 100 MHz | 4.3 % of reading | Fluke 5500A-SC600 Multiproduct Calibrator |
| | (100 to 300) MHz | 4.9 % of reading | |
| | (300 to 600) MHz | 7.2 % of reading | |

Electrical – DC/Low Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|--------------------------|---|--|
| Oscilloscopes – Amplitude ¹ | Up to 5 V _{p-p} | 2.3 % of reading + 0.35 mV | Fluke 5500A-SC600 Multiproduct Calibrator |

Length – Dimensional Metrology

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--------------------------------------|-------------------|---|---|
| Gage Blocks ³ | (0.005 to 4) in | (3.8 + 1L) μin | Gage Blocks, Gage Block Comparator |
| Long Gage Blocks ³ | (5 to 20) in | (4.1 + 1.4L) μin | Universal Length Measuring Machine, Gage Blocks |
| Plain Plug Gages ³ | (0.007 to 10) in | (8.2 + 3.3L) μin | Universal Length Measuring Machine, Gage Blocks |
| Height/Step Masters ³ | Up to 36 in | (16 + 4.1L) μin | Gage Blocks, Surface Plate, Indicator |
| Height Masters (Travel) ³ | Up to 1 in | (16 + 1.6L) μin | Gage Blocks, Surface Plate, Indicator |
| Micrometer Standards ³ | (0.5 to 10) in | (26 + 3.8L) μin | P&W Supermicrometer [®] , Gage Blocks |
| Micrometer Standards ³ | (26 to 48) in | (75 + 3.4L) μin | Mu-Checker, Indicator, Gage Blocks, Surface Plate |
| Plain Ring Gages ³ | (0.15 to 10) in | (12 + 4.4L) μin | Mahr Precimar ULM |
| Thread Wires ² | (0.007 to 0.2) in | 11.4 μin | Universal Length Measuring Machine, XX Cylinder |
| Pin Gages ³ | (0.011 to 2) in | (32 + 0.3L) μin | P&W Supermicrometer [®] |
| Pin Gages ³ | (0.011 to 2) in | (30 + 3.1L) μin | Zygo Lasermic |
| Thickness Gages (Leaf) ³ | Up to 1 in | (31 + 3.1L) μin | P&W Supermicrometer [®] |
| Tape Measures | Up to 50 ft | (0.056 + 0.000 05L) in | Comparison to Master Tape |
| Steel Rules ³ | Up to 72 in | (0.01 + 0.000 1L) in | Comparison to Master Ruler |

Length – Dimensional Metrology

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|--|---|--|
| Thread Plug Gages ³ Major Diameter | (0.06 to 8) in | (28 + 2.4L) μin | P&W Supermicrometer®, Thread Wires |
| Pitch Diameter (4 to 80) TPI | (0.06 to 8) in | (56 + 8L) μin | |
| Thread Ring Gages ³ Minor Diameter | (0.06 to 6) in (0.25 to 1) in | (94 + 8.2L) μin (21 + 87L) μin | Vision System, Intra-Micrometer |
| Thread Ring Gages ³ Pitch Diameter Solid (4 to 80) TPI | (0.06 to 6) in | (11 + 3L) μin | Mahr Precimar ULM, Plain Ring |
| Pitch Diameter Adjustable (4 to 80) TPI | (0.06 to 6) in | Tactical Fit | Set Plugs |
| Thread Rings, Adjustable ⁵ Pitch Diameter Tactile Fit (Set to Plug) | (0.06 to 6) in | See footnote | Set Plugs |
| Radius Gage | (0.010 to 2) in | (98 + 16L) μin | Vision System |
| Spheres ³ | (0.013 2 to 2) in | (15 + 3L) μin | Universal Length Measuring Machine, Gage Blocks |
| Squares ³ | (2 to 24) in | (60 + 2.5L) μin | Grade 0 Square Gage Blocks |
| Surface Plates ^{1,3} Overall Flatness | (8 to 60) in diagonal (34 to 161) in diagonal | (31 + 2.5L) μin (43 + 4.3L) μin | In accordance with ASME B89.3.7 using Planekator Level System |
| Local Area Flatness (Repeat Reading) | Up to 0.001 in | 40 μin | Repeat-o-Meter |
| Roughness Specimens | Up to 400 μin Ra | 2.7 μin | Profilometers |

Length – Dimensional Metrology

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---|-------------------------------|---|--|
| Artifacts and Fixtures ³ | | | |
| Length | Up to 16 in | (126 + 16L) μin | CMM |
| Diameter | Up to 12 in | (204 + 17L) μin | CMM |
| Angle | Up to 65° Up to 360° | 0.001 7° 0.006° | Sine Bar, Gage Blocks Vision System |
| Length | Up to 9 in | (162 + 1.4L) μin | Vision System |
| Touch Probe, X-Y Length | Up to 10 in | (95 + 7.2L) μin | Vision System |
| Touch Probe, Z Length | Up to 8 in | (83 + 6L) μin | Vision System |
| Height Gage ^{1,3} | Up to 36 in | (125 + 2L) μin | Gage Blocks, Surface Plate |
| Calipers ^{1,3} | Up to 60 in (60 to 120) in | (357 + 4.6L) μin (216 + 7.5L) μin | Gage Blocks |
| Outside Micrometers ^{1,3} | Up to 4 in (5 to 36) in | (29 + 3.3L) μin (49 + 4L) μin | Gage Blocks |
| Depth Micrometers ^{1,3} | Up to 12 in | (584 + 0.3L) μin | Gage Blocks, Surface Plate |
| Inside Micrometers ^{1,3} | (0.1 to 36) in | (574 + 0.6L) μin | Gage Blocks, Surface Plate |
| Bore Micrometers ³ | (0.15 to 10) in | (28 + 6.5L) μin | Ring Gages |
| Bench Micrometer ^{1,3} | | | |
| Travel Length | Up to 1 in | (16 + 2.5L) μin | Gage Blocks Optical Flat Sphere |
| Anvil Flatness | | 9 μin | |
| Anvil Parallelism | | 18 μin | |
| Universal Length Measuring Machine ^{1,3} | Up to 4 in | (3.9 + 4.2L) μin | Gage Blocks |
| Indicator ^{1,3} | | | |
| 0.001 in resolution | Up to 4 in | 580 μin | Indicator Tester, Gage Blocks |
| 0.0005 in resolution | Up to 2 in | (290 + 0.7L) μin | |
| 0.00025 in resolution | Up to 0.25 in | 145 μin | |
| 0.0001 in resolution | Up to 2 in | (58 + 0.8L) μin | |
| 0.000 05 in resolution | Up to 2 in | (34 + 8L) μin | |
| 0.000 02 in resolution | Up to 2 in | (31 + 7.4L) μin | |
| 0.000 01 in resolution | Up to 0.5 in | (16 + 20.L) μin | |
| Indicator ^{1,3} | | | |
| 0.001 in resolution | (0 to 1) in | (615 + 6L) μin | Indicator Tester |
| 0.0005 in resolution | (0 to 1) in | (317 + 1.2L) μin | |

Length – Dimensional Metrology

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|--|--|--|
| Ultrasonic Thickness Gages | (0.005 to 2) in | 580 μin | Gage Blocks |
| Magnetic Coating Thickness Gages ^{3,4} | (1 to 50) mils | (0.063 + 0.003L) mils | Precision Shims, Bench Micrometer |
| Profilometer (Ra) ¹ | (0 to 200) μin | 3.5 μin | Roughness Standard per ASME B46.1-2009 |
| Protractor ³ | Up to 180° | (0.03 + 0.001 8X)° | Granite Squares, Sine Bar |
| Optical Comparators ^{1,3} Magnification X-Y Linearity Squareness | 5x to 100x Up to 6 in Up to 6 in | (137 + 3.5L) μin (137 + 1L) μin 76 μin | Glass Scale, Length Standards, Spheres |
| Microscopes ³ Stage Travel | Up to 2 in | (160 + 11L) μin | Gage Blocks |
| Vision Systems ^{1,3} X-Y Linearity Angles | Up to 6 in Up to 360° | (162 + 1.2L) μin 0.005° | Glass Scale |
| CMM ^{1,3} Length Measurement Errors | Up to 48 in | (82 + 3.1L) μin | ISO 10360-2, ASME B89.4.10360.2 using Step Gage or Gage Blocks |

Mass and Mass Related

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|--|---|--|
| Gas Flow Speed (Anemometers) | Hotwire (490 to 3 300) ft/min | 4.7 % of reading + 3.1 ft/min | TSI 9535 VelociCalc Air Velocity Meter |
| | Vane (490 to 3 300) ft/min | 3.4 % of reading + 5.2 ft/min | |
| Gas Flow Meter | (50 to 1 000) sccm (1 to 50) slpm (50 to 250) slpm | 0.8 % of reading + 0.18 sccm 1 % of reading + 0.11 slpm 1 % of reading + 1 slpm | Alicat Flow Standard |
| Bench Micrometer Measuring Force | (4 to 40) ozf | 0.26 ozf | Force Gage |
| Force Gages ³ | (0.5 to 50) lbf (50 to 250) lbf | (0.002 + 0.000 4W) lbf (0.014 + 0.000 2W) lbf | NIST Class F Weights |
| Force Gages, Force Testing Machines ³ (Tension) | (10 to 300) lbf (40 to 2 000) lbf | (0.09 + 0.000 1F) lbf (0.28 + 0.000 1F) lbf | Load Cell within ASTM E74 Class A Ranges |

Mass and Mass Related

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|---|---|---|
| Force Gages, Force Testing Machines ³ (Compression) | (10 to 300) lbf (40 to 2 000) lbf | (0.09 + 0.000 2F) lbf (0.04 + 0.000 3F) lbf | Load Cell within ASTM E74 Class A Ranges |
| Force Testing Machine – Load Cells | (2 000 to 20 000) lbf | (10 + 0.000 1F) lbf | Comparison to Master Load Cells |
| Rockwell and Rockwell Superficial Hardness Testers ¹ | HRBW Low Middle High HRC Low Middle High HRFW Low Middle High HR15N Low Middle High HR30N Low Middle High HR45N Low Middle High HR15TW Low Middle High HR30TW Low Middle High HR45TW Low Middle High | 0.82 HRBW 0.87 HRBW 0.78 HRBW 0.49 HRC 0.46 HRC 0.38 HRC 0.77 HRFW 0.65 HRFW 0.93 HRFW 0.72 HR15N 0.7 HR15N 0.6 HR15N 0.67 HR30N 0.78 HR30N 0.6 HR30N 0.63 HR45N 0.61 HR45N 0.57 HR45N 0.86 HR15TW 0.79 HR15TW 0.51 HR15TW 0.77 HR30TW 0.93 HR30TW 0.6 HR30TW 0.64 HR45TW 0.59 HR45TW 0.72 HR45TW | Indirect Verification per ASTM E18 using test blocks. |

Mass and Mass Related

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---|--------------------------------------|---|--|
| Mass Determination (SI) | 1 g | 0.14 mg | OIML Class E2 Weights, Electronic Balance |
| | 2 g | 0.22 mg | |
| | 5 g | 0.2 mg | |
| | 10 g | 0.22 mg | |
| | 20 g | 0.25 mg | |
| | 50 g | 0.5 mg | |
| | 100 g | 0.73 mg | |
| Mass Determination (Avoirdupois) | 200 g | 1.2 mg | ASTM E617 Class 2 Weights, Electronic Balance |
| | 10 lb | 0.000 26 lb | |
| | 20 lb | 0.000 44 lb | |
| Low Pressure Gages ¹ (Magnehelic/Photohelic) | 50 lb | 0.000 92 lb | Druck DPI 802 Pressure Calibrator |
| | (-27.73 to 27.73) inH ₂ O | 0.005 % of reading + 0.034 inH ₂ O | |
| | (0 to 15) psig | 0.001 8 % of reading + 0.01 psi | |
| | (0 to 30) psig | 0.001 % of reading + 0.02 psi | |
| Low Pressure Gages ¹ (Magnehelic/Photohelic) | (0 to 50) psig | 0.001 7 % of reading + 0.03 psi | Hart ABB Differential Pressure Transmitter |
| | (30 to 200) inH ₂ O | 0.001 4 % of reading + 0.063 inH ₂ O | |
| Pneumatic Pressure Gage ¹ | Up to 3 000 psig | 0.03 % of reading + 0.32 psi | Comparison to Pace 1000 Pressure Indicator |
| Hydraulic Pressure Gage ¹ | Up to 15 000 psig | 0.12 % of reading + 1.7 psi | Keller Gage |
| Pneumatic Vacuum Gage ¹ | (-15 to 0) psiv | 0.009 psi | Druck DPI 802 Pressure Calibrator |
| Precision Balances ^{1,6} | Up to 120 g | (0.000 04 + 0.000 002 <i>M</i>) g | OIML Class E2 Mass and NIST Handbook 44 utilized for the calibration of the weighing system. |
| | (121 to 260) g | (0.000 16 + 0.000 000 5 <i>M</i>) g | |
| | (261 to 1 100) g | (0.000 41 + 0.000 0007 <i>M</i>) g | |
| Scales / Balances ^{1,6} (SI) | (1 101 to 5 000) g | (0.004 4 + 0.00 011 <i>M</i>) lb | NIST Class F Weights and NIST Handbook 44 utilized for the calibration of the weighing system. |
| | (5 001 to 17 000) g | (0.015 + 0.000 012 <i>M</i>) lb | |
| Scales / Balances ^{1,6} (Avoirdupois) | (37 to 110) lb | (0.001 + 0.000 1 <i>M</i>) lb | NIST Class F Weights and NIST Handbook 44 utilized for the calibration of the weighing system. |
| | (111 to 500) lb | (0.001 + 0.000 01 <i>M</i>) lb | |
| Torque Tools | 0.5 ozf·in to 1 000 lbf·ft | 0.35 % of reading | CDI Torque Tester |
| | (1 000 to 2 000) lbf·ft | 0.13 % of reading + 19 lbf·ft | |
| Torque Transducers | Up to 1 000 lbf·ft | 0.09 % of reading | Torque Arms, NIST Class F Weights |



ANSI National Accreditation Board

Mass and Mass Related

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---------------------------------------|-----------------------|---|--|
| Piston Operated Pipettes ³ | (10 to 1 000) μ L | (0.21 + 0.000 64X) μ l | Gravimetric Method using Precision Balance |

Thermodynamic

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---|--|--|---|
| Infrared Thermometers ¹ | 35 °C (35 to 100) °C (100 to 200) °C (200 to 300) °C (300 to 400) °C (400 to 500) °C | 0.5 °C 0.7 °C 1 °C 1.6 °C 2.1 °C 2.2 °C | Fluke 4181 Black Body Source (flat plate) $\epsilon = (0.9 \text{ to } 1)$, $\lambda = (8 \text{ to } 14) \mu\text{m}$ |
| Relative Humidity – Measure ¹ (Thermohygrometer) | (-20 to 15) °C (0 to 80) % RH (15 to 25) °C (0 to 80) % RH (25 to 40) °C (0 to 80) % RH | 1.1 % of reading + 1.25 % RH 0.4 % of reading + 1.3 %RH 1.1 % of reading + 1.25 % RH | Comparison to Vaisala MI70/HMP77 Temperature/Humidity Indicator/Probe |
| Temperature – Measure ¹ (Thermohygrometer) | (-70 to 180) °C | 0.3 °C | Comparison to Vaisala MI70/HMP77 Temperature/Humidity Indicator/Probe |
| Temperature Probes and Systems ^{1,3} | (-200 to 670) °C | (0.003 + 0.000 2T) °C | Hart Scientific Baths, Drywells, Fluke 5609 PRT |
| Liquid-in-Glass Thermometers ³ (Partial and Total Immersion) | (-20 to 600) °C | (0.08 + 0.000 9T) °C | Hart Scientific Bath, Fluke 5609 PRT |
| Temperature Sources ³ (Drywells, Liquids Baths, Water Baths, etc.) | (-15 to 110) °C (-30 to 125) °C (50 to 350) °C | (0.3 + 0.000 3T) °C (0.3 + 0.000 02T) °C (0.7 + 0.000 004T) °C | Fluke 5609 PRT w/ Display |

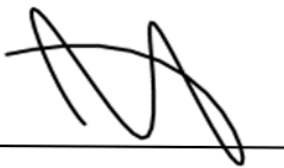
Time and Frequency

| Parameter/Equipment | Range | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---|-----------------------------------|--|--|
| Frequency – Source ¹ | 1 Hz to 50 MHz (50 to 600) MHz | 0.003 % of reading + 1.1 mHz 0.003 % of reading | Fluke 5500A Multiproduct Calibrator, Fluke PM 5193 Function Generator |
| Frequency – Measure ¹ | 1 Hz to 225 MHz | 0.37 Hz | HP 53131A Universal Frequency Counter |
| Timers and Stopwatches ¹ | (0.1 to 60) min | 0.006 % of reading + 35 ms | HP 53131A Universal Frequency Counter |
| Rotational Speed – Optical Tachometers ^{1,3} | Up to 60 000 rpm | 0.001 % of reading + 0.015 rpm | Fluke 5500A Multiproduct Calibrator, LED |
| Rotational Speed – Contact Tachometers and Testing Equipment ^{1,3} | Up to 1 800 rpm | 0.3 % of reading + 0.002 rpm | Comparison to Ametek 1726 Digital Tachometer |

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 shown is per wire for thread wire sets.
3. L = length in inches; D = diameter in inches; T = temperature applied; X = flow / frequency / volts / ohms / amps / capacitance applied; M = mass applied; F = force in kg; V = volume; W = weight in lb; A = angle in degrees; rpm = revolutions per minute.
4. 1 mil = 0.001 in.
5. The setting of an adjustable thread ring is not a measurement for which an uncertainty can be estimated. The method for this activity is an accredited activity.
6. The uncertainties for scales and balances are highly dependent upon the resolution of the unit under test. The uncertainties presented here do not include the resolution of the unit under test. The resolution will be included in the reported measurement uncertainty at the time of calibration.
7. The values presented here are nominal. The actual certified values will be used at the time of calibration along with the associated uncertainties.
8. The legal entity for this client is Transcat, Inc.
9. This scope is formatted as part of a single document including Certificate of Accreditation No. L2181-1.



Jason Stine, Vice President