



CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Transcat - Indianapolis
2845 Tobey Drive
Indianapolis, IN 46219

Fulfills the requirements of

ISO/IEC 17025:2017

and national standard

ANSI/NCSL Z540-1-1994 (R2002)

In the fields of

CALIBRATION and DIMENSIONAL MEASUREMENT

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: AC-2489.30



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)

Tangent Labs, A Transcat Company

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CALIBRATION AND DIMENSIONAL MEASUREMENT

Valid to: **September 7, 2025**

Certificate Number: **AC-2489.30**

CALIBRATION

Acoustics and Vibration

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Sound Level Measuring Devices ¹	94 dB		Sound Level Calibrator
	250 Hz	0.4 dB	
	1 kHz	0.4 dB	
	114 dB		
	250 Hz	0.4 dB	
	1 kHz	0.4 dB	
Sound Level – Measure ¹	(35 to 130) dB 63 Hz to 8 kHz	1.8 dB	Sound Level Meter

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH Meters ^{1,2}	4 pH	0.012 pH	Accredited Solutions
	7 pH	0.012 pH	
	10 pH	0.012 pH	

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Conductivity Meters ^{1,2}	5 µS/cm	0.32 µS/cm	Accredited Solutions
	10 µS/cm	0.32 µS/cm	
	100 µS/cm	0.82 µS/cm	
	1 000 µS/cm	3.3 µS/cm	
	10 000 µS/cm	36 µS/cm	
	100 000 µS/cm	300 µS/cm	
	150 000 µS/cm	590 µS/cm	
Refractometers ¹	(1.3 to 1.395) nD	0.0006 nD	Accredited Solutions
	(0 to 30) % Brix	0.032 % Brix	
Gas Monitors and Detectors ¹ CO (Carbon Monoxide)	0.002 5 % CO	0.000 16 % CO	Accredited Gases
	0.005 % CO	0.000 22 % CO	
	0.01 % CO	0.000 28 % CO	
	0.03 % CO	0.000 63 % CO	
	CO ₂ (Carbon Dioxide)	1 % CO ₂	
3 % CO ₂		0.068 % CO ₂	
5 % CO ₂		0.11 % CO ₂	
15 % CO ₂		0.31 % CO ₂	
LEL (Methane)	20 % LEL	2 % LEL	
O ₂ (Oxygen)	20.9 % O ₂	0.53 % O ₂	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH Meter Simulation ¹ (Electrical)	(0 to 15) pH	0.001 pH	Fluke 5522A Multiproduct Calibrator
Conductivity Meter Simulation ¹ (Resistance)	(10 to 100) µS	0.08 µS	Fluke 5522A Multiproduct Calibrator
	(101 to 1000) µS	0.09 µS	
	(1001 to 10 000) µS	0.08 µS	
	(10 001 to 100 000) µS	0.06 µS	
	(100 001 to 1 000 000) µS	0.04 µS	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ¹	Up to 220 μ A		Fluke 5730A/03 Multiproduct Calibrator
	(10 to 20) Hz	0.025 % of reading + 16 nA	
	(20 to 40) Hz	0.016 % of reading + 10 nA	
	40 Hz to 1 kHz	0.011 % of reading + 8 nA	
	(1 to 5) kHz	0.028 % of reading + 12 nA	
	(5 to 10) kHz	0.11 % of reading + 65 nA	
	(0.22 to 2.2) mA		
	(10 to 20) Hz	0.025 % of reading + 40 nA	
	(20 to 40) Hz	0.016 % of reading + 35 nA	
	40 Hz to 1 kHz	0.011 % of reading + 35 nA	
	(1 to 5) kHz	0.021 % of reading + 0.11 μ A	
	(5 to 10) kHz	0.11 % of reading + 0.65 μ A	
	(2.2 to 22) mA		
	(10 to 20) Hz	0.025 % of reading + 0.4 μ A	
	(20 to 40) Hz	0.016 % of reading + 0.35 μ A	
40 Hz to 1 kHz	0.011 % of reading + 0.35 μ A		
(1 to 5) kHz	0.021 % of reading + 0.55 μ A		
(5 to 10) kHz	0.11 % of reading + 10 μ A		
(22 to 220) mA			
(10 to 20) Hz	0.025 % of reading + 4 μ A		
(20 to 40) Hz	0.016 % of reading + 3.5 μ A		
40 Hz to 1 kHz	0.011 % of reading + 2.5 μ A		
(1 to 5) kHz	0.021 % of reading + 3.5 μ A		
(5 to 10) kHz	0.11 % of reading + 10 μ A		
(0.22 to 2.2) A			
20 Hz to 1 kHz	0.025 % of reading + 35 μ A		
(1 to 5) kHz	0.045 % of reading + 80 μ A		
(5 to 10) kHz	0.7 % of reading + 0.16 mA		
AC Current – Source ¹	(2.2 to 11) A 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.048 % of reading + 0.17 mA 0.096 % of reading + 0.38 mA 0.36 % of reading + 0.75 mA	Fluke 5730A/03 Multiproduct Calibrator, Fluke 5725A Amplifier
AC Current – Source ¹	(11 to 20.5) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.095 % of reading + 3.9 mA 0.12 % of reading + 3.9 mA 2.3 % of reading + 3.9 mA	Fluke 5522A Multiproduct Calibrator
AC Clamp-on Ammeters (Toroidal Type) Transformer Type Sensor ¹	(20 to 150) A (45 to 65) Hz (65 to 440) Hz (150 to 1 000) A (45 to 65) Hz (65 to 440) Hz	0.31 % of reading + 26 mA 0.84 % of reading + 47 mA 0.35 % of reading + 0.12 A 1.2 % of reading + 0.22 A	Fluke 5522A Multiproduct Calibrator, Fluke 5500A/Coil 50-turn Coil



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Clamp-on Ammeters (Non-Toroidal Type) Hall Effect Sensor ¹	(20 to 150) A (45 to 65) Hz (65 to 440) Hz (150 to 1 000) A (45 to 65) Hz (65 to 440) Hz	0.58 % of reading + 0.25 A 1.1 % of reading + 0.25 A 0.6 % of reading + 0.9 A 1.3 % of reading + 0.92 A	Fluke 5522A Multiproduct Calibrator, Fluke 5500A/Coil 50-turn Coil
AC Clamp-on Ammeter (Non-Toroidal Type) Hall Effect Sensor ¹	(1 to 6) kA (10 to 300) Hz (1 to 2) kA (300 to 440) Hz (2 to 6) kA (300 to 440) Hz	0.6 % of reading 0.8 % of reading 0.66 % of reading	Fluke 5522A Multiproduct Calibrator, Fluke 52120A Transconductance Amplifier, 3 kA and 6 kA Coil
AC Current – Measure ¹	Up to 200 μ A 1 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz (0.2 to 2) mA (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz (2 to 20) mA (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz (20 to 200) mA 1 Hz to 10 Hz 10 Hz to 10 kHz (10 to 30) kHz (0.2 to 2) A 10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (2 to 20) A 10 Hz to 2 kHz (2 to 10) kHz	0.031 % of reading + 20 nA 0.071 % of reading + 20 nA 0.4 % of reading + 20 nA 0.031 % of reading + 0.2 μ A 0.03 % of reading + 0.2 μ A 0.071 % of reading + 0.2 μ A 0.4 % of reading + 0.2 μ A 0.031 % of reading + 2 μ A 0.03 % of reading + 2 μ A 0.071 % of reading + 2 μ A 0.4 % of reading + 2 μ A 0.031 % of reading + 20 μ A 0.029 % of reading + 20 μ A 0.063 % of reading + 20 μ A 0.062 % of reading + 0.2 mA 0.074 % of reading + 0.2 mA 0.3 % of reading + 0.2 mA 0.082 % of reading + 2 mA 0.25 % of reading + 2 mA	Fluke 8508A 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 – Source ¹	Up to 2.2 mV		Fluke 5730A/03 Multiproduct Calibrator
	(10 to 20) Hz	0.16 % of reading + 4 μV	
	(20 to 40) Hz	0.1 % of reading + 4 μV	
	40 Hz to 20 kHz	0.078 % of reading + 4 μV	
	(20 to 50) kHz	0.13 % of reading + 4 μV	
	(50 to 100) kHz	0.17 % of reading + 5 μV	
	(100 to 300) kHz	0.33 % of reading + 10 μV	
	(300 to 500) kHz	0.47% of reading + 20 μV	
	500 kHz to 1 MHz	0.58 % of reading + 20 μV	
	(2.2 to 22) mV		
	(10 to 20) Hz	0.042 % of reading + 4 μV	
	(20 to 40) Hz	0.03 % of reading + 4 μV	
	40 Hz to 20 kHz	0.014 % of reading + 4 μV	
	(20 to 50) kHz	0.03 % of reading + 4 μV	
	(50 to 100) kHz	0.058 % of reading + 5 μV	
	(100 to 300) kHz	0.12 % of reading + 10 μV	
	(300 to 500) kHz	0.16 % of reading + 20 μV	
	500 kHz to 1 MHz	0.27 % of reading + 20 μV	
	(22 to 220) mV		
	(10 to 20) Hz	0.028 % of reading + 12 μV	
	(20 to 40) Hz	0.011 % of reading + 7 μV	
	40 Hz to 20 kHz	0.009 % of reading + 7 μV	
	(20 to 50) kHz	0.021 % of reading + 7 μV	
	(50 to 100) kHz	0.047 % of reading + 17 μV	
(100 to 300) kHz	0.091 % of reading + 20 μV		
(300 to 500) kHz	0.14 % of reading + 25 μV		
500 kHz to 1 MHz	0.28 % of reading + 45 μV		
(0.22 to 2.2) V			
(10 to 20) Hz	0.027 % of reading + 40 μV		
(20 to 40) Hz	0.01 % of reading + 15 μV		
40 Hz to 20 kHz	0.005 % of reading + 8 μV		
(20 to 50) kHz	0.008 % of reading + 10 μV		
(50 to 100) kHz	0.012 % of reading + 30 μV		
(100 to 300) kHz	0.043 % of reading + 80 μV		
(300 to 500) kHz	0.01 % of reading + 0.2 mV		
500 kHz to 1 MHz	0.18 % of reading + 0.3 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	(2.2 to 22) V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz (22 to 220) V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.028 % of reading + 0.4 mV 0.01 % of reading + 0.15 mV 0.005 % of reading + 50 μV 0.008 % of reading + 0.1 mV 0.011 % of reading + 0.2 mV 0.03 % of reading + 0.6 mV 0.1 % of reading + 2 mV 0.17 % of reading + 3.2 mV 0.028 % of reading + 4 mV 0.01 % of reading + 1.5 mV 0.006 % of reading + 0.6 mV 0.009 % of reading + 1 mV 0.016 % of reading + 2.5 mV 0.09 % of reading + 16 mV 0.44 % of reading + 40 mV 0.8 % of reading + 80 mV	Fluke 5730A/03 Multiproduct Calibrator
AC Voltage – Source ¹	(220 to 1 100) V 40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	0.011 % of reading + 4 mV 0.017 % of reading + 6 mV 0.061 % of reading + 11 mV	Fluke 5730A/03 Multiproduct Calibrator, Fluke 5725A Amplifier
AC Voltage – Source ¹ Extended Frequency Ranges	(220 to 750) V (30 to 50) kHz (50 to 100) kHz	0.061 % of reading + 11 mV 0.23 % of reading + 45 mV	Fluke 5730A/03 Multiproduct Calibrator, Fluke 5725A Amplifier
AC Voltage – Measure ¹	Up to 200 mV (1 to 10) Hz (10 to 40) Hz (40 to 100) Hz (0.1 to 2) kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.021 % of reading + 14 μV 0.017 % of reading + 4 μV 0.014 % of reading + 4 μV 0.013 % of reading + 2 μV 0.016 % of reading + 4 μV 0.04 % of reading + 8 μV 0.09 % of reading + 20 μV	Fluke 8508A 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	(0.2 to 2) V		Fluke 8508A 8.5 Digit Multimeter
	(1 to 10) Hz	0.019 % of reading + 0.12 mV	
	(10 to 40) Hz	0.014 % of reading + 20 μV	
	(40 to 100) Hz	0.011 % of reading + 20 μV	
	(0.1 to 2) kHz	89 μV/V of reading + 20 μV	
	(2 to 10) kHz	0.013 % of reading + 20 μV	
	(10 to 30) kHz	0.026 % of reading + 40 μV	
	(30 to 100) kHz	0.068 % of reading + 0.2 mV	
	(100 to 300) kHz	0.37 % of reading + 2 mV	
	(0.3 to 1) MHz	1.3 % of reading + 20 mV	
	(2 to 20) V		
	(1 to 10) Hz	0.019 % of reading + 1.2 mV	
	(10 to 40) Hz	0.014 % of reading + 0.2 mV	
	(40 to 100) Hz	0.011 % of reading + 0.2 mV	
	(0.1 to 2) kHz	90 μV/V + 0.2 mV	
	(2 to 10) kHz	0.013 % of reading + 0.2 mV	
	(10 to 30) kHz	0.026 % of reading + 0.4 mV	
	(30 to 100) kHz	0.068 % of reading + 2 mV	
	(100 to 300) kHz	0.37 % of reading + 20 mV	
	(0.3 to 1) MHz	2.2 % of reading + 0.2V	
	(20 to 200) V		
(1 to 10) Hz	0.02 % of reading + 12 mV		
(10 to 40) Hz	0.014 % of reading + 2 mV		
(40 to 100) Hz	0.011 % + 2 mV		
(0.1 to 2) kHz	90 μV/V + 2 mV		
(2 to 10) kHz	0.013 % of reading + 2 mV		
(10 to 30) kHz	0.026 % of reading + 4 mV		
(30 to 100) kHz	0.068 % of reading + 20 mV		
(200 to 1 000) V			
(1 to 10) Hz	0.019 % of reading + 70 mV		
(10 to 40) Hz	0.015 % of reading + 20 mV		
(0.04 to 10) kHz	0.014 % of reading + 20 mV		
(10 to 30) kHz	0.027 % of reading + 40 mV		
(30 to 100) kHz	0.071 % of reading + 0.2 V		
AC High Voltage – Measure ¹	Up to 28 kV 60 Hz	5.2 % of reading + 1.7 V	Keysight 34401A 6.5 Digit Multimeter, Fluke 80K-40 High Voltage Probe



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source ¹ (Simulation)	(0.22 to 0.4) nF (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	0.4 % of reading + 7.8 pF 0.4 % of reading + 7.8 pF 0.4 % of reading + 7.8 pF 0.21 % of reading + 7.8 pF 0.2 % of reading + 78 pF 0.21 % of reading + 78 pF 0.2 % of reading + 0.23 nF 0.21 % of reading + 0.78 nF 0.21 % of reading + 2.3 nF 0.2 % of reading + 7.8 nF 0.32 % of reading + 23 nF	Fluke 5522A Multiproduct Calibrator
Capacitance – Source ¹ (Simulation)	(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	0.37 % of reading + 78 nF 0.38 % of reading + 0.23 μF 0.35 % of reading + 0.78 μF 0.35 % of reading + 2.3 μF 0.35 % of reading + 7.8 μF 0.58 % of reading + 23 μF 0.85 % of reading + 78 μF	Fluke 5522A Multiproduct Calibrator
Capacitance – Measure ¹	1 kHz (1 to 1 000) pF (1 to 1 000) nF (1 to 1 000) μF	0.5 fF/pF + 23 fF 0.5 pF/nF + 0.88 pF 4.2 nF/μF	Hameg LCR Meter
DC Current – Source ¹	(0 to 220) μA (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A	40 μA/A + 6 nA 35 μA/A + 7 nA 35 μA/A + 40 nA 45 μA/A + 0.7 μA 80 μA/A + 12 μA	Fluke 5730A/03 Multiproduct Calibrator
DC Current – Source ¹	(2.2 to 3) A (3 to 11) A (11 to 20.5) A	0.3 mA/A + 31 μA 0.51 mA/A + 0.39 mA 0.93 mA/A + 0.58 mA	Fluke 5522A Multiproduct Calibrator
DC Clamp-on Ammeters (Non-Toroidal Type) Hall Effect Sensor ¹	(20 to 150) A (150 to 1 000) A (1 000 to 5 000) A	0.51 % of reading + 0.14 A 0.51 % of reading + 0.5 A 0.58 % of reading	Fluke 5522A Multiproduct Calibrator, Fluke 5500A/COIL, Fluke 55120A Transconductance Amplifier, 1 kA and 6 kA Coils



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Measure ¹	Up to 200 μ A (0.2 to 2) mA (2 to 20) mA (20 to 200) mA (0.2 to 2) A (2 to 20) A	13 μ A/A + 0.31 nA 13 μ A/A + 3.1 nA 14 μ A/A + 31 nA 47 μ A/A + 0.62 μ A 0.18 mA/A + 12 μ A 0.39 mA/A + 0.31 mA	Fluke 8508A 8.5 Digit Multimeter
DC Current – Measure ¹	(0 to 500) A	0.2 mA/A + 0.16 A	Fluke 8508A 8.5 Digit Multimeter, DC Current Shunt
DC Voltage – Source ¹	(0 to 220) mV (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1 100) V	7.5 μ V/V + 0.4 μ V 5 μ V/V + 0.7 μ V 3.5 μ V/V + 2.5 μ V 3.5 μ V/V + 4 μ V 5 μ V/V + 40 μ V 6.5 μ V + 0.4 mV	Fluke 5730A/03 Multiproduct Calibrator
DC Voltage – Source ¹ (Fixed Point)	10 V	0.31 μ V/V	Fluke 732A DC Voltage Reference Standard
DC Voltage – Measure ¹	Up to 200 mV (0.2 to 2) V (2 to 20) V (20 to 200) V (200 to 1 000) V	5.2 μ V/V + 90 nV 3.6 μ V/V + 0.39 μ V 3.5 μ V/V + 3.9 μ V 5.5 μ V/V + 39 μ V 5.5 μ V/V + 0.47 mV	Fluke 8508A 8.5 Digit Multimeter
DC High Voltage – Measure ¹	(1 to 20) kV (20 to 35) kV (35 to 40) kV	2 % of reading 1 % of reading 2 % of reading	Keysight 34401A 6.5 Digit Multimeter, Fluke 80K-40 High Voltage Probe
AC Power – Source ^{1,2,4} PF = 1	(3.3 to 9) mA (10 to 65) Hz 110 μ W to 3 mW 3 mW to 9 W (9 to 33) mA (10 to 65) W 300 μ W to 10 mW 10 mW to 33 W (33 to 90) mA (10 to 65) Hz (1 to 30) mW 30 mW to 90 W	0.13 % of reading 0.077 % of reading 0.089 % of reading 0.077 % of reading 0.071 % of reading 0.057 % of reading	Fluke 5520A Multiproduct Calibrator



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Power – Source ^{1,2,4} PF = 1			
(90 to 330) mA	(10 to 65) Hz (3 to 100) mW 100 mW to 300 W	0.089 % of reading 0.078 % of reading	Fluke 5520A Multiproduct Calibrator
(330 to 900) mA	(10 to 65) Hz (11 to 300) mW 300 mW to 900 W	0.071 % of reading 0.081 % of reading	
900 mA to 2.2 A	(10 to 65) Hz (30 to 720) mW 0.72 W to 2 kW	0.089 % of reading 0.079 % of reading	
(2.2 to 4.5) A	(10 to 65) Hz 80 mW to 1.4 W 1.4 W to 4.5 kW	0.088 % of reading 0.18 % of reading	
(4.5 to 20.5) A	(10 to 65) Hz 150 mW to 20kW	0.17 % of reading	
DC Power – Source ¹			
330 μW to 330 mA	11 μW to 1.1 mW (1.1 to 110) mW 110 mW to 110 W (110 to 330) W	0.024 % of reading 0.027 % of reading 0.024 % of reading 0.018 % of reading	Fluke 5520A Multiproduct Calibrator
330 mA to 3 A	11 μW to 110 mW 110 mW to 990 W 990 W to 3 kW	0.044 % of reading 0.053 % of reading 0.01 % of reading	
(3 to 20.5) A	99 mW to 0.99 W 0.99 W to 6.8 kW (6.8 to 20.5) kW	0.088 % of reading 0.07 % of reading 0.04 % of reading	
Phase – Source ¹	(0 to 90)° (10 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.11° 0.21° 0.39° 1.9° 3.9° 7.8°	Fluke 5522A 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	Pt 385, 100 Ω		Fluke 5522A Multiproduct Calibrator
	(-200 to -80) °C	0.039 °C	
	(-80 to 0) °C	0.039 °C	
	(0 to 100) °C	0.054 °C	
	(100 to 300) °C	0.07 °C	
	(300 to 400) °C	0.078 °C	
	(400 to 630) °C	0.093 °C	
	(630 to 800) °C	0.18 °C	
	Pt 385, 200 Ω		
	(-200 to -80) °C	0.031 °C	
	(-80 to 0) °C	0.031 °C	
	(0 to 100) °C	0.031 °C	
	(100 to 260) °C	0.039 °C	
	(260 to 300) °C	0.093 °C	
	(300 to 400) °C	0.1 °C	
	(400 to 600) °C	0.11 °C	
	(600 to 630) °C	0.12 °C	
	Pt 385, 500 Ω		
	(-200 to -80) °C	0.031 °C	
	(-80 to 0) °C	0.039 °C	
	(0 to 100) °C	0.039 °C	
	(100 to 260) °C	0.047 °C	
	(260 to 300) °C	0.062 °C	
	(300 to 400) °C	0.062 °C	
	(400 to 600) °C	0.07 °C	
	(600 to 630) °C	0.085 °C	
	Pt 385, 1 kΩ		
	(-200 to -80) °C	0.023 °C	
(-80 to 0) °C	0.023 °C		
(0 to 100) °C	0.031 °C		
(100 to 260) °C	0.039 °C		
(260 to 300) °C	0.047 °C		
(300 to 400) °C	0.054 °C		
(400 to 600) °C	0.054 °C		
(600 to 630) °C	0.18 °C		

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	Pt 3916, 100 Ω		Fluke 5522A Multiproduct Calibrator
	(-200 to -190) °C	0.19 °C	
	(-190 to -80) °C	0.031 °C	
	(-80 to 0) °C	0.039 °C	
	(0 to 100) °C	0.047 °C	
	(100 to 260) °C	0.054 °C	
	(260 to 300) °C	0.062 °C	
	(300 to 400) °C	0.07 °C	
	(400 to 600) °C	0.078 °C	
	(600 to 630) °C	0.18 °C	
	Pt 3926, 100 Ω		
	(-200 to -80) °C	0.039 °C	
	(-80 to 0) °C	0.039 °C	
	(0 to 100) °C	0.054 °C	
	(100 to 300) °C	0.07 °C	
	(300 to 400) °C	0.078 °C	
	(400 to 630) °C	0.093 °C	
PtNi 385, 120 Ω			
(-80 to 0) °C	0.062 °C		
(0 to 100) °C	0.062 °C		
(100 to 260) °C	0.1 °C		
Cu 427, 10 Ω			
(-100 to 260) °C	0.23 °C		
Electrical Simulation of Thermocouple Indicating Devices – Source/Measure ¹	Type B		Fluke 5522A Multiproduct Calibrator
	(600 to 800) °C	0.35 °C	
	(800 to 1 000) °C	0.28 °C	
	(1 000 to 1 550) °C	0.24 °C	
	(1 550 to 1 820) °C	0.26 °C	
	Type C		
	(0 to 150) °C	0.24 °C	
	(150 to 650) °C	0.21 °C	
	(650 to 1000) °C	0.24 °C	
	(1 000 to 1 800) °C	0.39 °C	
	(1 800 to 2 316) °C	0.65 °C	
	Type E		
	(-250 to -100) °C	0.39 °C	
	(-100 to -25) °C	0.13 °C	
(-25 to 350) °C	0.12 °C		
(350 to 650) °C	0.13 °C		
(650 to 1 000) °C	0.17 °C		

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 5522A Multiproduct Calibrator
	(-210 to -100) °C	0.21 °C	
	(-100 to -30) °C	0.13 °C	
	(-30 to 150) °C	0.12 °C	
	(150 to 760) °C	0.14 °C	
	(760 to 1 200) °C	0.18 °C	
	Type K		
	(-200 to -100) °C	0.26 °C	
	(-100 to -25) °C	0.15 °C	
	(-25 to 120) °C	0.13 °C	
	(120 to 1 000) °C	0.21 °C	
	(1 000 to 1 372) °C	0.31 °C	
	Type L		
	(-200 to -100) °C	0.29 °C	
	(-100 to 800) °C	0.21 °C	
	(800 to 900) °C	0.14 °C	
	Type N		
	(-200 to -100) °C	0.31 °C	
	(-100 to -25) °C	0.18 °C	
	(-25 to 120) °C	0.15 °C	
	(120 to 410) °C	0.15 °C	
	(410 to 1 300) °C	0.21 °C	
	Type R		
	(0 to 250) °C	0.46 °C	
	(250 to 400) °C	0.29 °C	
	(400 to 1 000) °C	0.26 °C	
	(1 000 to 1 767) °C	0.32 °C	
	Type S		
(0 to 250) °C	0.45 °C		
(250 to 1 000) °C	0.3 °C		
(1 000 to 1 400) °C	0.29 °C		
(1 400 to 1 767) °C	0.36 °C		
Type T			
(-250 to -150) °C	0.49 °C		
(-150 to 0) °C	0.19 °C		
(0 to 120) °C	0.13 °C		
(120 to 400) °C	0.12 °C		
Type U			
(-200 to 0) °C	0.44 °C		
(0 to 600) °C	0.21 °C		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Magnetic Flux Density – Source ^{1,5} (Gauss Meters)	(0 to 35) G	0.26 % of reading	Digital Multimeter, Helmholtz Coils
Resistance – Source ¹ (Simulated)	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 (0.33 to 1.1) GΩ	32 μΩ/Ω + 0.78 mΩ 24 μΩ/Ω + 1.2 mΩ 22 μΩ/Ω + 1.1 mΩ 22 μΩ/Ω + 1.6 mΩ 22 μΩ/Ω + 1.6 mΩ 22 μΩ/Ω + 1.6 mΩ 22 μΩ/Ω + 1.6 mΩ 22 μΩ/Ω + 0.16 Ω 22 μΩ/Ω + 0.16 Ω 27 μΩ/Ω + 1.6 Ω 26 μΩ/Ω + 1.6 Ω 66 μΩ/Ω + 23 Ω 0.1 mΩ/Ω + 39 Ω 0.19 mΩ/Ω + 1.9 kΩ 0.41 mΩ/Ω + 2.3 kΩ 0.23 % of reading + 78 kΩ 1.2 % of reading + 0.39 MΩ	Fluke 5522A Multiproduct Calibrator
Resistance – Source ¹ (Fixed Points)	0 Ω 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	40 μΩ 95 μΩ/Ω 95 μΩ/Ω 23 μΩ/Ω 23 μΩ/Ω 10 μΩ/Ω 10 μΩ/Ω 6.5 μΩ/Ω 6.5 μΩ/Ω 6.5 μΩ/Ω 6.5 μΩ/Ω 8.5 μΩ/Ω 8.5 μΩ/Ω 13 μΩ/Ω 18 μΩ/Ω 40 μΩ/Ω 47 μΩ/Ω 0.011 % of reading	Fluke 5730A/03 Multiproduct Calibrator
Resistance – Source ¹ (Fixed Artifacts)	1 Ω 10 kΩ	9.3 μΩ/Ω 7.6 μΩ/Ω	Fluke 742A Resistance Standards



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Source ¹ (Fixed Artifacts)	1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ 1 GΩ 10 GΩ 100 GΩ	15 μΩ/Ω 15 μΩ/Ω 20 μΩ/Ω 25 μΩ/Ω 31 μΩ/Ω 0.013 % of reading 0.07 % of reading 0.25 % of reading 0.45 % of reading	Standard Resistors
DC Resistance – Measure ¹ Normal Mode	Up to 2 Ω (2 to 20) Ω (20 to 200) Ω (0.2 to 2) kΩ (2 to 20) kΩ (20 to 200) kΩ (0.2 to 2) MΩ (2 to 20) MΩ (20 to 200) MΩ (0.2 to 2) GΩ	17 μΩ/Ω + 3.9 μΩ 9.5 μΩ/Ω + 14 μΩ 7.8 μΩ/Ω + 47 μΩ 8.1 μΩ/Ω + 0.47 mΩ 7.8 μΩ/Ω + 4.7 mΩ 8.6 μΩ/Ω + 47 mΩ 9.5 μΩ/Ω + 93 mΩ 27 μΩ/Ω + 9.3 Ω 0.12 mΩ/Ω + 0.93 kΩ 0.14 % of reading + 93 kΩ	Fluke 8508A 8.5 Digit Multimeter
DC Resistance – Measure ¹ Low Current Mode	Up to 2 Ω (2 to 20) Ω (20 to 200) Ω (0.2 to 2) kΩ (2 to 20) kΩ (20 to 200) kΩ (0.2 to 2) MΩ (2 to 20) MΩ (20 to 200) MΩ (0.2 to 2) GΩ	17 μΩ/Ω + 3.9 μΩ 9.4 μΩ/Ω + 14 μΩ 8 μΩ/Ω + 0.14 mΩ 8.2 μΩ/Ω + 1.4 mΩ 7.9 μΩ/Ω + 14 mΩ 8.6 μΩ/Ω + 93 mΩ 21 μΩ/Ω + 0.93 Ω 88 μΩ/Ω + 93 Ω 0.14 % of reading + 93 kΩ 0.14 % of reading + 0.93 MΩ	Fluke 8508A 8.5 Digit Multimeter
DC Resistance – Measure ¹ High Voltage Mode	(2 to 20) MΩ (20 to 200) MΩ (0.2 to 2) GΩ (2 to 20) GΩ	25 μΩ/Ω + 9.3 Ω 70 μΩ/Ω + 0.93 kΩ 0.19 mΩ/Ω + 93 kΩ 0.14 % of reading + 9.3 MΩ	Fluke 8508A opt 001 8.5 Digit Multimeter
Inductance – Source ¹ (Variable Artifact)	1 kHz 1 μH to 999 mH	0.5 % of reading	Inductance Decade Box characterized with Hameg LCR Meter
Inductance – Measure ¹	1 kHz 1 μH to 100 H	0.5 % of reading	Hameg LCR Meter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes ^{1,2}			
Amplitude DC			
into 50 Ω load	(-6.6 to 6.6) V	0.22 % of reading + 31 μV	
into 1 MΩ load	(-130 to 130) V	0.12 % of reading + 31 μV	
Amplitude Square Wave			
into 50 Ω load	10 Hz to 10 kHz		
into 1 MΩ load	1 mVp-p to 6.6 Vp-p	0.22 % of reading + 31 μV	
	10 Hz to 1 kHz		
	1 mVp-p to 130 Vp-p	0.078 % of reading + 31 μV	
	(1 to 10) kHz		
	1 mVp-p to 130 Vp-p	0.19 % of reading + 31 μV	
Timing – Generate			
into 50 Ω load	1 ns to 20 ms	0.000 22 % reading	
	50 ms	0.005 9 % reading	
	100 ms	0.009 8 % reading	
	200 ms	0.018 % reading	
	500 ms	0.041 % reading	
	1 s	0.08 % reading	
	2 s	0.16 % reading	
	5 s	0.39 % reading	
Rise Time – Generate			
into 50 Ω Load	5 mVp-p to 2.5 Vp-p		
Rate: 1 kHz to 2 MHz	(200 to 300) ps	50 ps	
Rate: 2 MHz to 10 MHz	(250 to 350) ps	50 ps	
Leveled Sine Wave –			
Generate			
into 50 Ω load	5 mVp-p to 5.5 Vp-p		
	50 kHz	1.8 % of reading + 0.23 mV	
	100 kHz to 100 MHz	2.8 % of reading + 0.23 mV	
	(100 to 300) MHz	3.2 % of reading + 0.23 mV	
	(300 to 600) MHz	4 % of reading + 0.23 mV	
	5 mVp-p to 3.5 Vp-p		
	600 MHz to 1.1 GHz	5.5 % of reading + 0.23 mV	

Fluke 5522A/11
Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes ^{1,2} Bandwidth/Flatness – Measure (50 kHz Reference) into 50 Ω load	5 mVp-p to 5.5 Vp-p 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	1.4 % of reading + 78 μV 1.8 % of reading + 78 μV 3.2 % of reading + 78 μV	Fluke 5522A/11 Multiproduct Calibrator
	5 mVp-p to 3.5 Vp-p 600 MHz to 1.1 GHz	4 % of reading + 78 μV	
Input Impedance – Measure into 50 Ω load into 1 MΩ load	(40 to 60) Ω (0.5 to 1.5) MΩ	0.082 % of reading 0.081 % of reading	
Input Capacitance – Measure	(5 to 50) pF	3.9 % of reading + 0.39 pF	
Wave Generator – Source Amplitude (Sine, Square, Triangle) into 50 Ω load into 1 MΩ load	10 Hz to 10 kHz 1.8 mVp-p to 2.5 Vp-p 1.8 mVp-p to 55 Vp-p	2.3 % of reading + 78 μV 2.3 % of reading + 78 μV	
Frequency	10 Hz to 10 kHz	0.001 9 % of reading + 12 mHz	

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Gage Blocks, Length Standards ³ Standard Size Length	(0.005 to 0.5) in (0.55 to 1) in 2 in 3 in 4 in	2.6 μin 3.4 μin 5.5 μin 7.7 μin 9.9 μin	Mechanical Comparison using Master Gage Blocks

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Gage Blocks, Length Standards ³ Standard Size Length	5 in	13 μin	Mechanical Comparison using Master Gage Blocks
	6 in	15 μin	
	7 in	27 μin	
	8 in	30 μin	
	10 in	37 μin	
	12 in	44 μin	
	16 in	58 μin	
	20 in	73 μin	
Non-standard Size Length	(0.001 to 0.005) in	4.9 μin	
	(0.005 to 1) in	(3 + 2L) μin	
	(1 to 6) in	(8.3 + 2.3L) μin	
	(6 to 20) in	(26 + 2.2L) μin	
	(20 to 40) in	(69 + 1.7L) μin	
Feeler Gages, ¹ Shims	Up to 1 in	15 μin	
	Up to 25.4 mm	0.38 μm	
Height Masters ¹	Up to 24 in	24 μin	Indicator with Gage Amplifier, Gage Blocks, Surface Plate
	Up to 600 mm	0.61 μm	
Height Gages ^{1,3,5}	Up to 60 in	(8 + 3.5L) μin	Gage Blocks, Surface Plate
	Up to 1 500 mm	(0.2 + 0.003 5L) μm	
Micrometers ^{1,3,5}	Up to 20 in	(7 + 4.5L) μin	Gage Blocks
	Up to 500 mm	(0.2 + 0.005L) μm	
Calipers ^{1,3,5}	Up to 80 in	(24 + 4.6L) μin	Gage Blocks
	Up to 2 000 mm	(0.6 + 0.005L) μm	
LVDT's, Indicators ^{1,3,5}	Up to 12 in	(3 + 3.3L) μin	Gage Blocks, Surface Plates
	Up to 300 mm	(0.08 + 0.005L) μm	
Measuring Tapes, Rulers ¹	Up to 5 ft	0.006 3 in	Ruler Calibrator
	(5 to 10) ft	0.013 in	
	(10 to 48) ft	140 μin/in	
	(48 to 1 000) ft	120 μin/in	

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Angle Blocks ^{1,3}	(0.25 to 90)°	(13 + 0.07A)''	Sine Bar, Gage Blocks, Surface Plate
Angle Measuring Devices ^{1,3} (Protractors, Inclinometers, Squares, Angle Gages, etc.)	0.005 6'' to 5° (5 to 20)° (20 to 35)° (35 to 45)° (45 to 60)° (60 to 75)° (75 to 85)°	3.3'' 6.5'' 12'' 17'' 28'' 59'' 190''	5 in Sine Bar, Gage Blocks
Chamfer Gage ¹	(0.15 to 2) in (3.8 to 50) mm	290 μin 7.5 μm	Reference Ring Gages
Cylindrical Square Squareness	Up to 24 in Up to 600 mm	25 μin 0.6 μm	Indicator, Height Stand, Surface Plate
Electronic Levels, Inclination Levels ³	Up to 1 000''	0.23''	Sine Bar, Gage Blocks, Surface Plate
Spirit Levels, Clinometers ⁵	Up to 4 ft Up to 1.2 m	50 μin/ft 1.3 μm/m	Sine Bar, Gage Blocks, Surface Plate
Sine Plates/Bars ³ Parallelism Angle	Up to 15 in (0 to 45)°	78 μin (10 + 0.6A)''	Surface Plate, Indicator with Gage Amplifier, Gage Blocks, Angle Blocks
Optical Flats/Parallels	Up to 4 in Up to 100 mm	6.4 μin 0.16 μm	Comparison to Master Optical Flat
Cylindrical Pins/Plugs ³	(0.003 to 40) in	(8 + 0.8D) μin	Gage Blocks, Universal Length Measuring Machine
Cylindrical Rings/Bores ³	(0.02 to 33) in	(4.8 + 0.9D) μin	Gage Blocks, Universal Length Measuring Machine
CMM Spheres, Gage Balls	(0.015 to 4) in (0.38 to 100) mm	12 μin 0.3 μm	Gage Blocks, Universal Length Measuring Machine

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Thread Wires	(0.003 to 0.825) in 76 µm to 30 mm	10 µin 0.25 µm	Master Thread Wires, Gage Blocks, Universal Length Measuring Machine
Thread Pitch Gages	Up to 6 in	430 µin	Optical Comparator
Thread Plug Gages ^{1,3} Pitch Diameter, (40 to 80) TPI	Up to 1.25 in (1.25 to 4.5) in (4.5 to 7) in	97 µin 100 µin 110 µin	Universal Length Measuring Machine, Master Thread Wires, Gage Blocks
Major Diameter	Up to 1.75 in (1.75 to 7) in	59 µin (56 + 2D) µin	Universal Length Measuring Machine, Gage Blocks
Step Height	Up to 1 in	160 µin	Gage Blocks, Test Stand
Thread Ring Gages ³ Pitch Diameter	Up to 20 in	(66 + 0.26D) µin	Universal Length Measuring Machine, Thread Balls, Gage Blocks
Minor Diameter	Up to 20 in	45 µin	
Thread Ring Gages ^{1,3} Inner Pitch Diameter	Up to 2 in (2 to 12) in	(140 + 27.5D) µin (160 + 18D) µin	Comparison to Master Thread Plug Gages
Adjustable Thread Rings ³ Pitch Diameter	Up to 2 in	(140 + 2D) µin	Tactile Fit to Class X Master Set Plugs
Parallels, Straight Edges	Up to 12 in	40 µin	Indicator, Height Stand, Surface Plate
Planekator	Up to 48 in	57 µin	Laser System, Surface Plate
Profilometers, Surface Testers ¹ (Primary)	Ra = 120 µin	8.4 µin	Master Surface Patch
Profilometers, Surface Testers ¹ (Secondary)	Ra = (10 to 200) µin	8 % of reading + 2.6 µin	Surface Patches
Roughness Standards/Patches (ISO Type C)	Ra = (10 to 200) µin	7 % of reading + 1.5 µin	Master Surface Patch, Profilometer
Coating Thickness Meters ¹	(0.94 to 20.24) mils	5.8 % of reading	Coating Thickness Standards

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
V-Blocks Groove	Up to 4 in	64 μin	Indicator, Height Stand, Surface Plate
Squareness	Up to 24 x 24 x 24 in	45 μin	
Bench Micrometers, Universal Length Measuring Machines ^{1,3,5} Standard Length	(> 0.005 to 1) in 2 in 3 in 4 in 5 in 6 in 7 in 8 in 10 in 12 in 16 in 20 in	(2.5 + 0.5L) μin 4.2 μin 4.9 μin 6.4 μin 8.1 μin 8.9 μin 9.7 μin 11 μin 12 μin 14 μin 17 μin 20 μin	Gage Blocks, Long Gage Blocks
Non-standard Length	(20 to 40) in	(20 + 0.86L) μin	
Coordinate Measuring Machines (CMM's) ^{1,3} Linear Displacement Accuracy (X, Y, Z)	Up to 72 in	(8 + 3L) μin	Gage Blocks, Optical Flats
Volumetric Repeatability	Up to 72 in	100 μin	Ball Bar
Probe Repeatability	Up to 72 in	25 μin	Sphere
Optical Comparators ^{1,3} X,Y Measuring Stage Travel	Up to 12 in	(130 + 17L) μin	Calibration Grids
Squareness	(0.4 to 1) in	120 μin	Calibration Grids
Magnification	10X to 62.5X	(240 + 21L) μin	Magnification Checker
Radius Gages	Up to 2 in	460 μin	Optical Comparator

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Granite Surface Plates ^{1,3}			
Overall Flatness	(8.49 to 299.25) <i>DL</i>	$4 \sqrt{DL} \mu\text{in}$	In accordance with ASME B89.3.7 using Electronic Level System
Local Area Flatness (Repeat Readings)	Up to 0.005 in	40 μin	Repeat-o-Meter
Torque Wheels, Torque Arms ³	Up to 40 in	$(470 + 2L) \mu\text{in}$	Surface Plate, Indicator with Gage Amplifier, Gage Blocks, Digital Outside Micrometer
Depth Micrometers ^{1,3}	(0.01 to 72) in	$(50 + 55.1L) \mu\text{in}$	Gage Blocks

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Air Velocity Measuring Devices (Anemometers, Thermal, Pitot, Vane-style and Similar Equipment) ¹	(30 to 250) ft/min (250 to 1 500) ft/min (1 500 to 9 000) ft/min	2.3 % of reading + 2.6 ft/min 2.3 % of reading + 6 ft/min 1.2 % of reading + 17 ft/min	Wind Tunnel
Gas Mass Flow ¹ (Flow Meters, Flow Controllers, Rotameters, and Leak Orifices)	(1 to 10) sccm (10 to 1 000) sccm	0.25 sccm 0.22 % of reading	Fluke molBloc-L Calibration System
	(1 to 1 000) slpm	0.1 % of reading	Fluke molBloc-S Calibration System
Liquid Flow Meters ¹	Up to 10 gpm	1.4 % of reading + 0.001 8 gpm	Calibration by Time and Mass
Hydrometers	(0.6 to 0.64) SG (0.64 to 1.67) SG (1.67 to 2) SG	0.002 5 SG 0.001 4 SG 0.005 SG	Comparison to Reference Hydrometer per ASTM E126.
Kinematic Viscosity Meters ¹	< 10 mm ² /s (11 to 100) mm ² /s (101 to 1000) mm ² /s (1001 to 10 000) mm ² /s (10 001 to 100 000) mm ² /s	0.25 % of reading 0.32 % of reading 0.37 % of reading 0.44 % of reading 0.51 % of reading	Accredited Viscosity Standard, Temperature Indicator with Probe



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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Viscosity Cups ¹ (Kinematic Viscosity @ 25 °C) Zahn Shell Ford	(5 to 1 800) mm ² /s	2.2 % of reading	Accredited Viscosity Standard per ASTM D4212
	(2 to 1 300) mm ² /s	2.2 % of reading	ASTM D4212
	(2 to 1 400) mm ² /s	2.2 % of reading	ASTM D1200
Piston Operated Volumetric Apparatus ⁷ (Pipettes, Syringes, Burettes, Liquid, Handlers, Dispensers)	(1 to 2 000) µL (2000 to 10 000) µL (10 000 to 100 000) µL	94 nL 0.22 µL 2 µL	Gravimetric Method using Electronic Balances and ASTM E617 Class 1 Weights.
Volume Measuring Equipment ¹	(0.001 to 4 000) mL	0.8 µL	Per ASTM E542 using Temperature Indicator with Probe, Electronic Balance, Distilled Water, Barometer
Load Cells, Force Testers, Force Gages ¹ (Tension and Compression)	(25 to 250) cN (250 to 2 000) cN	5.2 cN 52 cN	Correx Gram Gauge
	(0 to 500) lbf	0.088 % of reading	NIST Class F Weights
	(100 to 5 000) lbf (5 000 to 10 000) lbf (10 000 to 25 000) lbf (25 000 to 50 000) lbf	0.008 % of reading + 1.7 lbf 0.013 % of reading + 1.7 lbf 0.013 % of reading + 4.2 lbf 0.013 % of reading + 8.3 lbf	Tovey Engineering Calibration System
Durometers ¹ (Type A and C) Indenter Dimensions Extension Length Diameter Angle Radius Spring Force	Up to 0.2 in Up to 1 in Up to 35° Up to 1 in	160 µin 170 µin 0.1° 170 µin	Direct Verification per ASTM D2240 using Optical Comparator
	(0 to 100) Duro	0.34 Duro	Durometer Calibrator
Shore Durometer Calibrators Dimensional Measurements	Up to 8 in	480 µin	Optical Comparator
Mass	Up to 4 kg	30 mg	Single Substitution Method using Electronic Balance



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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Rockwell Hardness and Superficial Testers ¹	HRBW (80 to 100) HRBW (60 to 79) HRBW (40 to 59) HRBW HRC (60 to 65) HRC (35 to 55) HRC (20 to 30) HRC	0.48 HRBW 0.77 HRBW 1.1 HRBW 0.37 HRC 0.48 HRC 0.57 HRC	Indirect verification per ASTM E18 using hardness test blocks.
Mass Determination ¹ (Variable)	1 mg to 5 g (5 to 30) g (30 to 200) g (200 to 500) g (500 to 2000) g (2 to 10) kg (10 to 30) kg (30 to 45) kg	21 µg 24 µg 0.21 mg 2.1 mg 21 mg 0.21 g 0.24 g 0.45 g	Electronic Balances, OIML Class E1 Weights, ASTM E617 Class 1 Weights
Mass Determination (Fixed Points)	1 mg 2 mg 5 mg 10 mg 20 mg 50 mg 100 mg 200 mg 500 mg 1 g 2 g 5 g 10 g 20 g 50 g 100 g 200 g 500 g 1 kg	4.2 µg 4.2 µg 4.2 µg 4.2 µg 4.2 µg 4.3 µg 4.5 µg 4.5 µg 4.5 µg 8.6 µg 9.1 µg 11 µg 15 µg 19 µg 28 µg 18 µg 0.13 mg 0.91 mg 0.86 mg	Electronic Balances, OIML Class E1 Weights
Pneumatic Pressure Measuring Equipment ¹ (Absolute, Gauge)	(0.1 to 15) psi	0.003 4 % of reading + 0.000 5 psi	Ruska 7010 Pressure Controller/Calibrator
	(0.1 to 1 000) psi	0.006 % of reading + 0.015 psi	Ruska 7215I Pressure Controller/Calibrator



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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pressure Measuring Equipment ¹ (Absolute, Gauge, Negative and Positive)	(-104 to -7.5) kPa (-7.5 to -2.9) kPa (-2.9 to -0.75) kPa (-0.75 to 0.75) kPa (0.75 to 2.9) kPa	0.007 7 % of reading + 5.2 Pa 0.009 1 % of reading 0.009 % of reading + 35 mPa 0.007 5 % of reading + 51 mPa 0.009 % of reading + 35 mPa	Fluke PPC4 Pressure Controller/Calibrator
Pressure Measuring Equipment ¹ (Absolute, Gauge, Negative and Positive)	(2.9 to 7.5) kPa (7.5 to 26) kPa (26 to 63) kPa (63 to 700) kPa (700 to 7 000) kPa	0.009 1 % of reading 0.007 7 % of reading + 1.3 Pa 0.009 % of reading + 50 mPa 0.008 % of reading + 0.7 Pa 0.008 % of reading + 0.3 Pa	Fluke PPC4 Pressure Controller/Calibrator
Pressure Measuring Equipment (Absolute, Gauge)	(7 000 to 82 737) kPa	0.005 % of reading	Ruska 2400HL Hydraulic Piston Gauge
Pneumatic Only Pressure Measuring Equipment Absolute, Gauge	(9 to 385) kPa (70 to 825) kPa (140 to 7 650) kPa	0.001 2 % of reading + 0.1 Pa 0.002 % of reading + 0.6 Pa 0.002 % of reading + 1.2 Pa	Fluke PG7601 Gas Piston Gauge
Scales and Balances ^{1,8} Metric (SI)	Up to 500 mg (0.5 to 5) g (5 to 10) g (10 to 20) g (20 to 100) g (100 to 200) g (0.2 to 2) kg (2 to 20) kg	22 µg 29 µg 39 µg 54 µg 0.28 mg 0.43 mg 0.002 2% of reading 0.004 2% of reading	ASTM E617 Class 1 weights and NIST HB44 utilized in the calibration of the weighing system.
Scales and Balances ^{1,8} Avoirdupois	Up to 0.5 lb (0.5 to 1) lb (1 to 2 000) lb	0.026 % of reading 0.019 % of reading 0.013 % of reading	NIST Class F weights and NIST HB44 utilized in the calibration of the weighing system.
Scales and Balances ^{1,8} Metric (SI)	Up to 250 g (250 to 500) g (0.5 to 908) kg	0.026 % of reading 0.019 % of reading 0.013 % of reading	NIST Class F weights and NIST HB44 utilized in the calibration of the weighing system.
Torque Wrenches, Torque Watches ¹	(1 to 1 000) lbf·in (1 to 1 000) lbf·ft	0.52 % of reading 0.52 % of reading	Torque Transducers, Torque Indicators, Manual Loader
Torque Transducers, Torque Meters ¹	(1 to 1 000) lbf·in (1 to 1 000) lbf·ft	0.09 % of reading 0.08 % of reading	Torque Wheels, Torque Arms, NIST Class F Weights

Photometry and Radiometry

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Light Meters	Up to 40 lux (40 to 400) lux (400 to 4 000) lux (4 000 to 40 000) lux	3.6 % of reading + 0.2 lux 3.6 % of reading + 2 lux 3.6 % of reading + 20 lux 4.5 % of reading + 200 lux	Comparison to Master Light Meter

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Dew Point Measuring Equipment ¹	(-25 to 68) °C	0.15 °C	Thunder Scientific 2500 Two-pressure Humidity Generator
Dew Point – Measure ¹	(-15 to 20) °C	0.26 °C	Chilled Mirror
Relative Humidity – Source ¹	(-10 to 15) °C (10 to 75) % RH (75 to 95) %RH (15 to 35) °C (10 to 95) %RH (35 to 70) °C (10 to 50) %RH (50 to 75) %RH (75 to 95) %RH	0.5 %RH 0.65 %RH 0.5 %RH 0.5 %RH 0.7 %RH 0.85 %RH	Thunder Scientific 2500 Two-Pressure Humidity Generator
Relative Humidity – Measure ₁	(10 to 95) %RH	1.3 %RH	Chilled Mirror
Temperature Measuring Equipment	0.01 °C	1.5 mK	Triple Point of Water
Temperature Measuring Equipment by Comparison ^{2,3} NBPLN ₂ Hg In Sn Zn Al	-195 °C -38.8 °C 156.6 °C 231.9 °C 419.5 °C 660.3 °C	4 mK 5 mK 5 mK 5 mK 4 mK 10 mK	Comparison to Fluke 1595A Super Thermometer, Fluke 5628 Secondary PRT
Temperature – Measure ¹ (PRT, RTD, Thermistor, Thermocouple, Stirred Baths, Liquid Baths)	(-95 to 700) °C	10 mK	Comparison to SPRT and Indicator

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Infrared Thermometers ¹	(-15 to 0) °C	0.83 °C	Blackbody Source (Flat Plate) $\lambda = (8 \text{ to } 14) \mu\text{m}$, $\epsilon = (0.9 \text{ to } 1)$
	(0 to 50) °C	0.66 °C	
	(50 to 100) °C	0.67 °C	
	(100 to 120) °C	0.72 °C	
	(120 to 200) °C	0.97 °C	
	(200 to 350) °C	1.6 °C	
	(350 to 500) °C	2.2 °C	

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source/Measure Reference ¹	10 MHz	3.7 pHz/Hz	Fluke 910R GPS Frequency Standard
Frequency – Source ¹	1 μ Hz to 80 MHz	0.58 μ Hz/Hz	Agilent 33250A Arbitrary Waveform Generator
	250 kHz to 3 GHz	0.58 μ Hz/Hz	Agilent E4432B RF Signal Generator
Frequency – Measure ¹	1 Hz to 12.4 GHz	51 pHz/Hz	Agilent 53132A Universal Frequency Counter
AC Duty Cycle – Source ¹ Square Wave: < 3.3 V _{p-p} Freq: 0.1 Hz to 100 kHz	(1 to 10) % Duty Cycle 10 μ s to 100 s	0.62 % of reading + 78 ns	Fluke 5522A Multiproduct Calibrator
	(10 to 49) % Duty Cycle 10 μ s to 100 s	0.039 % of reading + 78 ns	
	50 % Duty Cycle 10 μ s to 100 s	0.001 6 % of reading + 78 ns	
	(51 to 90) % Duty Cycle 10 μ s to 100 s	0.039 % of reading + 78 ns	
	(90 to 99) % Duty Cycle 10 μ s to 100 s	0.62 % of reading + 78 ns	
Stopwatches, Timers ¹	Up to 19.99 s/d	58 ms/d	Helmut Klein TM-4500 Timometer
Tachometers – Optical Pickup ^{1,3}	(0 to 60 000) rpm	0.000 23 % of reading + 0.001 2 rpm	Agilent 33250A Arbitrary Waveform Generator, LED

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Rotation Speed – Measure ^{1,3} (Conveyor Belts, Line Speed, Centrifuges, and Mechanical Tachometers)	(6 to 8 300) rpm	1.7 rpm	Comparison to Optical Tachometer
	(8 300 to 99 999) rpm	2.6 rpm	
	(6 to 8 300) rpm	2.4 rpm	Comparison to Mechanical Tachometer
	(8 300 to 99 999) rpm	3 rpm	

DIMENSIONAL MEASUREMENT

1 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Dimensional Measurement – 1D ¹	Up to 12 in	1 500 μin	Digital Caliper utilized as the reference standard for 1-D Length Measurements.
	Up to 1 in	150 μin	Digital Outside Micrometer utilized as the reference standard for 1-D Length Measurements.
	Up to 6 in	150 μin	Digital Depth Micrometer utilized as the reference standard for 1-D Length Measurements.
	Up to 1 in	600 μin	Gage Pins utilized as the reference standard for 1-D Length Measurements.
Surface Finish ¹	Ra = (10 to 200) μin	7 % of reading + 1.5 μin	Profilometer utilized as a reference standard for Dimensional Inspection.

2 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Dimensional Measurement – 2D	Up to 6 in	(420 + 0.52L) μin	Optical Comparator utilized as the reference standard for 2-D Length Measurements.

2 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Dimensional Measurement – 2D	Up to 30 in	200 μin	CMM utilized as the reference standard for 2-D Length Measurements.

3 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Dimensional Measurements – 3D ³ (Volumetric)	X-axis: Up to 18 in Y-axis: Up to 20 in Z-axis: Up to 16 in	(300 + 43L) μin (300 + 44L) μin (300 + 42L) μin	CMM utilized as the reference standard for 3-D Length Measurements.

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. The values represented here are nominal values. The certified values and associated uncertainty will be reported at the time of calibration.
3. L = length in inches or millimeters; rpm = revolutions per minute; PF = Power Factor; A = Angle in degrees ($^{\circ}$); $"$ = arcsecond; D = diameter in inches or millimeters; DL = diagonal length in inches; NBPLN₂ = Boiling Point of Liquid Nitrogen.
4. The uncertainties shown are for the most favorable conditions. There is an increase in uncertainty that corresponds to the laboratory's AC voltage and current uncertainties at different frequencies other than the ones shown. Power factors (PF) other than the one shown contribute to the power uncertainty. PF is related to the cosine of phase. Therefore, uncertainties track the laboratory's phase uncertainty closely at PF near one but are magnified heavily as PF approaches zero. The lab may also report reactive power, apparent power, and power factor under this accreditation. If needed, contact the laboratory for more information regarding uncertainties at frequency and power factor combinations other than the ones shown.
5. At the time of Calibration, $0.6R$ will be added to the Measurement Uncertainty, where R = resolution of the unit under calibration.
6. ΔP measurement with density correction for standard condition normalization.
7. The contributions from "the best existing device" are not included in the CMC presented claim.
8. 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.
9. Volume calculations are based on independent linear measurements.
10. The legal entity name for this client is Transcat, Inc.
11. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2489.30.



Jason Stine, Vice President