



CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Transcat - St. Louis
647 Trade Center Blvd
Chesterfield, MO 63005

Fulfills the requirements of

ISO/IEC 17025:2017

and the 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: AC-2489.13



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 – St. Louis
647 Trade Center Blvd.
Chesterfield, MO 63005
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CALIBRATION AND DIMENSIONAL MEASUREMENT

Valid to: **September 7, 2025**

Certificate Number: **AC-2489.13**

CALIBRATION

Acoustics and Vibration

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Sound Measuring Equipment ¹	1 kHz		Comparison to SPL Calibrator
	94 dB 114 dB	0.39 dB 0.39 dB	

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH Meters ^{1,2}	4 pH	0.014 pH	Comparison to Accredited pH Solutions
	7 pH	0.015 pH	
	10 pH	0.025 pH	
Conductivity Meters ^{1,2}	10 µS	0.12 µS	Comparison to Accredited Conductivity Solutions
	100 µS	0.86 µS	
	1000 µS	5.9 µS	
	1430 µS	8.5 µS	

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 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz 100 μ A to 1 mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (1 to 10) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (10 to 100) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz 100 mA to 1 A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.46 % of reading + 35 nA 0.17 % of reading + 35 nA 0.072 % of reading + 35 nA 0.072 % of reading + 35 nA 0.46 % of reading + 0.23 μ A 0.17 % of reading + 0.23 μ A 0.071 % of reading + 0.23 μ A 0.038 % of reading + 0.23 μ A 0.46 % of reading + 2.3 μ A 0.17 % of reading + 2.3 μ A 0.071 % of reading + 2.3 μ A 0.038 % of reading + 2.3 μ A 0.48 % of reading + 23 μ A 0.17 % of reading + 23 μ A 0.071 % of reading + 23 μ A 0.037 % of reading + 23 μ A 0.46 % of reading + 0.23 mA 0.19 % of reading + 0.23 mA 0.097 % of reading + 0.23 mA 0.12 % of reading + 0.23 mA	Comparison to Keysight 3458A Opt 002 8.5 Digit Multimeter
AC Current – Measure ¹	(1 to 3) A 10 Hz to 5 kHz (5 to 10) kHz (3 to 10) A 10 Hz to 5 kHz (5 to 10) kHz	0.16 % of reading + 2 mA 0.41 % of reading + 21 mA 0.18 % of reading + 6 mA 0.36 % of reading + 70 mA	Comparison to Fluke 8845A 6.5 Digit Multimeter
AC Current – Source ¹	Up to 120 μ A (3 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.02 % of reading + 7.8 nA 0.02 % of reading + 7.8 nA 0.02 % of reading + 7.8 nA 0.12 % of reading + 32 nA 0.39 % of reading + 0.78 μ A	Comparison to Fluke 5560A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ¹	(0.12 to 1.2) mA		Comparison to Fluke 5560A Multiproduct Calibrator
	(3 to 45) Hz	0.02 % of reading + 78 nA	
	45 Hz to 1 kHz	0.02 % of reading + 78 nA	
	(1 to 5) kHz	0.02 % of reading + 78 nA	
	(5 to 10) kHz	0.12 % of reading + 78 nA	
	(10 to 30) kHz	0.39 % of reading + 3.9 μA	
	(1.2 to 12) mA		
	(3 to 45) Hz	0.02 % of reading + 0.78 μA	
	45 Hz to 1 kHz	0.02 % of reading + 0.78 μA	
	(1 to 5) kHz	0.02 % of reading + 0.78 μA	
	(5 to 10) kHz	0.12 % of reading + 0.78 μA	
	(10 to 30) kHz	0.39 % of reading + 7.8 μA	
	(12 to 120) mA		
	(3 to 45) Hz	0.02 % of reading + 7.8 μA	
	45 Hz to 1 kHz	0.012 % of reading + 3.9 μA	
	(1 to 5) kHz	0.02 % of reading + 6.3 μA	
	(5 to 10) kHz	0.12 % of reading + 7.8 μA	
	(10 to 30) kHz	0.39 % of reading + 78 μA	
	(0.12 to 1.2) A		
	(3 to 45) Hz	0.02 % of reading + 78 μA	
	45 Hz to 1 kHz	0.02 % of reading + 39 μA	
	(1 to 5) kHz	0.02 % of reading + 63 μA	
	(5 to 10) kHz	0.12 % of reading + 0.24 mA	
	(10 to 30) kHz	0.39 % of reading + 0.24 mA	
(1.2 to 3.1) A			
(3 to 45) Hz	0.03 % of reading + 0.39 mA		
45 Hz to 1 kHz	0.024 % of reading + 0.24 mA		
(1 to 5) kHz	0.03 % of reading + 0.24 mA		
(5 to 10) kHz	0.2 % of reading + 0.39 mA		
(3.1 to 12) A			
(3 to 45) Hz	0.03 % of reading + 0.78 mA		
45 Hz to 1 kHz	0.024 % of reading + 0.39 mA		
(1 to 5) kHz	0.03 % of reading + 0.63 mA		
(5 to 10) kHz	0.2 % of reading + 0.78 mA		
(12 to 30.2) A			
(3 to 45) Hz	0.078 % of reading + 7.8 mA		
45 Hz to 1 kHz	0.055 % of reading + 6.3 mA		
(1 to 5) kHz	0.39 % of reading + 6.3 mA		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current Clamp-on Meters ¹ (Toroidal Type) Transformer Type Sensor	(20 to 150 A) (45 to 65) Hz (65 to 440) Hz	0.3 % of reading + 26 mA 0.83 % of reading + 47 mA	Comparison to Fluke 5522A Multiproduct Calibrator, Fluke 5500A/COIL 50-turn Coil
	(150 to 1 000) A (45 to 65) Hz (65 to 440) Hz	0.35 % of reading + 0.12 A 1.1 % of reading + 0.22 A	
	(1 000 to 1 500) A (45 to 440) Hz	0.51% of reading + 0.31 A	
AC Current Clamp-on Meters ¹ (Non-Toroidal Type) Hall Effect Sensor	(20 to 150 A) (45 to 65) Hz (65 to 440) Hz	0.57 % of reading + 0.25 A 1 % of reading + 0.25 A	Comparison to Fluke 5522A Multiproduct Calibrator, Fluke 5500A/COIL 50-turn Coil
	(150 to 1 000) A (45 to 65) Hz (65 to 440) Hz	0.6 % of reading + 0.9 A 1.3 % of reading + 0.92 A	
	(1 000 to 1 500) A (45 to 440) Hz	0.53% of reading + 0.31 A	
AC Power – Source ^{1,3} (10 to 65) Hz Power Factor = 1	(3.3 to 9) mA (0.11 to 3) mW 3 mW to 9 W	0.13 % of reading 0.077 % of reading	Comparison to Fluke 5522A Multiproduct Calibrator
	(9 to 33) mA (0.3 to 10) mW 10 mW to 33 W	0.089 % of reading 0.077 % of reading	
	(33 to 90) mA (1 to 30) mW 30 mW to 90 W	0.071 % of reading 0.057 % of reading	
	(90 to 330) mA (3 to 100) mW 100 mW to 300 W	0.089 % of reading 0.078 % of reading	
	(0.33 to 0.9) A (11 to 300) mW 300 mW to 900 W	0.071 % of reading 0.081 % of reading	
	(0.9 to 2.2) A 30 mW to 0.72 W 720 mW to 2 kW	0.089 % of reading 0.079 % of reading	
	(2.2 to 4.5) A 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 (0.15 to 6.7) W 6.7 W to 20 kW	0.17 % of reading 0.17 % of reading	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	(1 to 10) mV		Comparison to Keysight 3458A Opt 002 8.5 Digit Multimeter
	(1 to 40) Hz	0.04 % of reading + 3.5 μ V	
	40 Hz to 1 kHz	0.03 % of reading + 1.2 μ V	
	(1 to 20) kHz	0.04 % of reading + 1.2 μ V	
	(20 to 50) kHz	0.15 % of reading + 1.2 μ V	
	(50 to 100) kHz	0.59 % of reading + 1.2 μ V	
	(100 to 300) kHz	4.6 % of reading + 2.3 μ V	
	300 kHz to 1 MHz	1.5 % of reading + 5.8 μ V	
	(1 to 4) MHz	8.1 % of reading + 8.1 μ V	
	(10 to 100) mV		
	(1 to 40) Hz	0.013 % of reading + 4.6 μ V	
	40 Hz to 1 kHz	0.009 7 % of reading + 2.3 μ V	
	(1 to 20) kHz	0.017 % of reading + 2.3 μ V	
	(20 to 50) kHz	0.038 % of reading + 2.3 μ V	
	(50 to 100) kHz	0.093 % of reading + 2.3 μ V	
	(100 to 300) kHz	0.36 % of reading + 12 μ V	
	300 kHz to 1 MHz	1.2 % of reading + 12 μ V	
	(1 to 2) MHz	1.8 % of reading + 12 μ V	
	(2 to 4) MHz	4.7 % of reading + 81 μ V	
	(4 to 8) MHz	4.7 % of reading + 92 μ V	
	(8 to 10) MHz	17 % of reading + 0.12 mV	
	(0.1 to 1) V		
	(1 to 40) Hz	0.008 8 % of reading + 46 μ V	
	40 Hz to 1 kHz	0.008 3 % of reading + 23 μ V	
(1 to 20) kHz	0.017 % of reading + 23 μ V		
(20 to 50) kHz	0.036 % of reading + 23 μ V		
(50 to 100) kHz	0.093 % of reading + 23 μ V		
(100 to 300) kHz	0.35 % of reading + 0.12 mV		
300 kHz to 1 MHz	1.2 % of reading + 0.12 mV		
(1 to 2) MHz	1.8 % of reading + 0.12 mV		
(2 to 4) MHz	4.6 % of reading + 0.81 mV		
(4 to 8) MHz	4.6 % of reading + 0.92 mV		
(8 to 10) MHz	17 % of reading + 1.2 mV		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	(1 to 10) V		Comparison to Keysight 3458A Opt 002 8.5 Digit Multimeter
	(1 to 40) Hz	0.009 5 % of reading + 0.46 mV	
	40 Hz to 1 kHz	0.023 % of reading + 0.23 mV	
	(1 to 20) kHz	0.017 % of reading + 0.23 mV	
	(20 to 50) kHz	0.036 % of reading + 0.23 mV	
	(50 to 100) kHz	0.093 % of reading + 0.23 mV	
	(100 to 300) kHz	0.35 % of reading + 1.2 mV	
	300 kHz to 1 MHz	1.2 % of reading + 1.2 mV	
	(1 to 2) MHz	1.8 % of reading + 1.2 mV	
	(2 to 4) MHz	4.6 % of reading + 8.1 mV	
	(4 to 8) MHz	4.6 % of reading + 9.2 mV	
	(8 to 10) MHz	17 % of reading + 12 mV	
	(10 to 100) V		
	(1 to 40) Hz	0.024 % of reading + 4.6 mV	
	40 Hz to 1 kHz	0.024 % of reading + 2.3 mV	
	(1 to 20) kHz	0.024 % of reading + 2.3 mV	
	(20 to 50) kHz	0.041 % of reading + 2.3 mV	
	(50 to 100) kHz	0.14 % of reading + 2.3 mV	
	(100 to 300) kHz	0.46 % of reading + 12 mV	
	300 kHz to 1 MHz	1.7 % of reading + 12 mV	
(100 to 700) V			
(1 to 40) Hz	0.048 % of reading + 46 mV		
40 Hz to 1 kHz	0.048 % of reading + 23 mV		
(1 to 20) kHz	0.071 % of reading + 23 mV		
(20 to 50) kHz	0.19 % of reading + 23 mV		
(50 to 100) kHz	0.35 % of reading + 23 mV		
AC High Voltage – Measure ¹	(0.7 to 5) kV		Comparison to Vitretek 4700 Digital HV Meter, Associated High Voltage Probes
	10 mHz to 10 Hz	0.14 % of reading + 0.17 V	
	(10 to 30) Hz	0.12 % of reading + 0.29 V	
	(30 to 50) Hz	0.099 % of reading + 0.37 V	
	(50 to 70) Hz	0.068 % of reading + 0.37 V	
	(70 to 100) Hz	0.099 % of reading + 0.37 V	
	(100 to 200) Hz	0.099 % of reading + 0.37 V	
	(200 to 450) Hz	0.48 % of reading + 0.17 V	
(450 to 600) Hz	0.47 % of reading + 0.17 V		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC High Voltage – Measure ¹	(5 to 30) kV		Comparison to Vitrek 4700 Digital HV Meter, Associated High Voltage Probes
	10 mHz to 10 Hz	0.19 % of reading + 2.4 V	
	(10 to 30) Hz	0.13 % of reading + 2.4 V	
	(30 to 50) Hz	0.11 % of reading + 2.4 V	
	(50 to 70) Hz	0.077 % of reading + 2.4 V	
	(70 to 100) Hz	0.11 % of reading + 2.4 V	
	(100 to 200) Hz	0.11 % of reading + 2.4 V	
	(200 to 450) Hz	0.7 % of reading + 2.4 V	
	(450 to 600) Hz	1.4 % of reading + 2.4 V	
	(30 to 50) kV		
	10 mHz to 10 Hz	0.24 % of reading + 2.5 V	
	(10 to 30) Hz	0.18 % of reading + 2.5 V	
	(30 to 50) Hz	0.13 % of reading + 2.5 V	
	(50 to 70) Hz	0.1 % of reading + 2.5 V	
	(70 to 100) Hz	0.13 % of reading + 2.5 V	
	(100 to 200) Hz	0.69 % of reading + 2.5 V	
	(200 to 450) Hz	2.9 % of reading + 2.5 V	
	(50 to 70) kV		
	10 mHz to 10 Hz	0.37 % of reading + 2.6 V	
	(10 to 30) Hz	0.26 % of reading + 2.6 V	
(30 to 50) Hz	0.16 % of reading + 2.6 V		
(50 to 70) Hz	0.16 % of reading + 2.6 V		
(70 to 100) Hz	1.2 % of reading + 2.6 V		
(100 to 200) Hz	1.2 % of reading + 2.6 V		
(200 to 450) Hz	17 % of reading + 2.6 V		
AC Voltage – Source ¹	Up to 12 mV		Comparison to Fluke 5560A Multiproduct Calibrator
	(3 to 5) Hz	0.2 % of reading + 5.5 μV	
	(5 to 10) Hz	0.068 % of reading + 5.5 μV	
	10 Hz to 20 kHz	0.012 % of reading + 4.7 μV	
	(20 to 50) kHz	0.03 % of reading + 4.7 μV	
	(50 to 100) kHz	0.12 % of reading + 12 μV	
	(100 to 300) kHz	0.63 % of reading + 24 μV	
	(300 to 500) kHz	0.63 % of reading + 24 μV	
	(12 to 120) mV		
	(3 to 5) Hz	0.2 % of reading + 5.5 μV	
	(5 to 10) Hz	0.068 % of reading + 5.5 μV	
	10 Hz to 20 kHz	0.011 % of reading + 4.7 μV	
	(20 to 50) kHz	0.028 % of reading + 6.3 μV	
	(50 to 100) kHz	0.063 % of reading + 16 μV	
	(100 to 300) kHz	0.16 % of reading + 24 μV	
	(300 to 500) kHz	0.16 % of reading + 24 μV	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source ¹	(0.12 to 1.2) V		Comparison to Fluke 5560A Multiproduct Calibrator
	(3 to 5) Hz	0.2 % of reading + 59 μV	
	(5 to 10) Hz	0.068 % of reading + 55 μV	
	(10 to 40) Hz	0.011 % of reading + 47 μV	
	40 Hz to 20 kHz	0.011 % of reading + 6.3 μV	
	(20 to 50) kHz	0.024 % of reading + 11 μV	
	(50 to 100) kHz	0.055 % of reading + 32 μV	
	(100 to 300) kHz	0.15 % of reading + 63 μV	
	(300 to 500) kHz	0.15 % of reading + 63 μV	
	(1.2 to 12) V		
	(3 to 5) Hz	0.2 % of reading + 0.59 mV	
	(5 to 10) Hz	0.068 % of reading + 0.59 mV	
	(10 to 40) Hz	0.011 % of reading + 0.28 mV	
	40 Hz to 20 kHz	0.011 % of reading + 39 μV	
	(20 to 50) kHz	0.024 % of reading + 39 μV	
	(50 to 100) kHz	0.055 % of reading + 98 μV	
	(100 to 300) kHz	0.16 % of reading + 0.47 mV	
	(300 to 500) kHz	0.16 % of reading + 0.47 mV	
	(12 to 70) V		
	(3 to 5) Hz	0.2 % of reading + 5.9 mV	
	(5 to 10) Hz	0.068 % of reading + 5.9 mV	
	(10 to 40) Hz	0.011 % of reading + 2.8 mV	
	40 Hz to 20 kHz	0.011 % of reading + 0.39 mV	
	(20 to 50) kHz	0.024 % of reading + 0.39 mV	
(50 to 100) kHz	0.055 % of reading + 0.97 mV		
(100 to 300) kHz	0.14 % of reading + 16 mV		
(70 to 120) V			
(3 to 5) Hz	0.2 % of reading + 5.9 mV		
(5 to 10) Hz	0.068 % of reading + 5.9 mV		
(10 to 40) Hz	0.011 % of reading + 2.8 mV		
40 Hz to 20 kHz	0.011 % of reading + 0.39 mV		
(20 to 50) kHz	0.024 % of reading + 0.39 mV		
(50 to 100) kHz	0.055 % of reading + 0.97 mV		
(120 to 330) V			
(3 to 5) Hz	0.2 % of reading + 59 mV		
(5 to 10) Hz	0.068 % of reading + 59 mV		
10 Hz to 20 kHz	0.011 % of reading + 6.3 mV		
(20 to 50) kHz	0.024 % of reading + 6.3 mV		
(50 to 100) kHz	0.12 % of reading + 9.7 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	(330 to 1 020) V (3 to 5) Hz (5 to 10) Hz 10 Hz to 10 kHz	0.2 % of reading + 59 mV 0.068 % of reading + 59 mV 0.011 % of reading + 63 mV	Comparison to Fluke 5560A Multiproduct Calibrator
DC Current – Measure ¹	Up to 100 μ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	0.003 3 % of reading + 0.92 nA 0.002 9 % of reading + 5.8 nA 0.002 9 % of reading + 58 nA 0.004 6 % of reading + 0.58 μ A 0.013 % of reading + 12 μ A	Comparison to Keysight 3458A Opt 002 8.5 Digit Multimeter
DC Current – Measure ¹	(1 to 3) A	0.096 % of reading + 0.47 mA	Comparison to Fluke 8846A 6.5 Digit Multimeter
DC Current – Measure ¹	(3 to 10) A	0.17 % of reading	Comparison to Fluke 8845A 6.5 Digit Multimeter
DC High Current – Measure ¹	(10 to 100) A	0.3 % of reading	Comparison to Empro Current Shunt, Fluke 8845A 6.5 Digit Multimeter
DC Current – Source ¹	Up to 120 μ A (0.12 to 1.2) mA (1.2 to 12) mA (12 to 120) mA (0.12 to 1.2) A (1.2 to 3.1) A (3.1 to 12) A (12 to 30.2) A	0.009 8 % of reading + 4.7 nA 0.007 8 % of reading + 12 nA 0.007 8 % of reading + 63 nA 0.007 8 % of reading + 0.63 μ A 0.013 % of reading + 7.8 μ A 0.024 % of reading + 0.12 mA 0.024 % of reading + 0.2 mA 0.078 % of reading + 0.39 mA	Comparison to Fluke 5560A Multiproduct Calibrator
DC Current Clamp-on Meters ¹ (Non-Toroidal Type) Hall Effect Sensor	(20 to 150) A (150 to 1 000) A (1 000 to 1 500) A	0.51 % of reading + 0.14 A 0.51 % of reading + 0.5 A 0.6 % of reading + 20 mA	Comparison to Fluke 5522A Multiproduct Calibrator, Fluke 5500A/COIL 50-turn Coil

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Power – Source ^{1,3}	(0.33 to 330) mA 11 μW to 1.1 mW (1.1 to 110) mW (0.11 to 110) W (110 to 330) W (0.33 to 3) A 11 μW to 110 mW (0.11 to 990) W (0.99 to 3) kW (3 to 20.5) A (99 to 990) mW 0.99 W to 6.8 kW (6.8 to 20.5) kW	0.024 % of reading 0.027 % of reading 0.024 % of reading 0.018 % of reading 0.044 % of reading 0.053 % of reading 0.009 6 % of reading 0.088 % of reading 0.07 % of reading 0.04 % of reading	Comparison to Fluke 5522A Multiproduct Calibrator
DC Voltage – Measure ¹	Up to 100 mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 500) V (500 to 800) V (800 to 1 000) V	0.000 83 % of reading + 0.58 μV 0.000 53 % of reading + 0.58 μV 0.000 53 % of reading + 0.58 μV 0.000 77 % of reading + 35 μV 0.001 5 % of reading + 0.12 mV 0.001 8 % of reading + 0.12 mV 0.002 1 % of reading + 0.12 mV	Comparison to Keysight 3458A Opt 002 8.5 Digit Multimeter
DC High Voltage – Measure ¹	(1 to 10) kV (10 to 20) kV (20 to 30) kV (30 to 40) kV (40 to 50) kV (50 to 60) kV (60 to 70) kV (70 to 80) kV (80 to 90) kV (90 to 100) kV	0.039 % of reading + 92 mV 0.038 % of reading + 2.4 V 0.041 % of reading + 2.4 V 0.047 % of reading + 2.4 V 0.056 % of reading + 2.4 V 0.071 % of reading + 2.4 V 0.089 % of reading + 2.4 V 0.12 % of reading + 2.5 V 0.15 % of reading + 2.5 V 0.17 % of reading + 2.5 V	Comparison to Vitretek 4700 Digital HV Meter, Associated High Voltage Probes
DC Voltage – Source ¹	Up to 120 mV (0.12 to 1.2) V (1.2 to 12) V (12 to 120) V (120 to 1 020) V	0.000 93 % of reading + 0.62 μV 0.000 64 % of reading + 0.78 μV 0.000 62 % of reading + 7.8 μV 0.000 85 % of reading + 78 μV 0.000 86 % of reading + 0.78 mV	Comparison to Fluke 5560A Multiproduct Calibrator



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Resistance – Measure/Source ¹	Up to 10 Ω (10 to 100) Ω (0.1 to 1) kΩ (1 to 10) kΩ (10 to 100) kΩ (0.1 to 1) MΩ (1 to 10) MΩ (10 to 100) MΩ (0.1 to 1) GΩ	18 μΩ/Ω + 58 μΩ 15 μΩ/Ω + 0.58 mΩ 13 μΩ/Ω + 0.58 mΩ 12 μΩ/Ω + 5.8 mΩ 13 μΩ/Ω + 58 mΩ 21 μΩ/Ω + 2.3 Ω 62 μΩ/Ω + 0.12 kΩ 0.059 % of reading + 1.2 kΩ 0.82 % of reading + 12 kΩ	Comparison to Keysight 3458A Opt 002 8.5 Digit Multimeter characterized with a High Accuracy Decade Resistor.
DC Resistance – Source ¹ (Simulation)	Up to 12 Ω (12 to 120) Ω (0.12 to 1.2) kΩ (1.2 to 12) kΩ (12 to 120) kΩ (0.12 to 1.2) MΩ (1.2 to 12) MΩ (12 to 120) MΩ (0.12 to 1.2) GΩ	0.002 % of reading + 0.78 mΩ 0.002 % of reading + 0.78 mΩ 0.002 % of reading + 1.6 mΩ 0.002 % of reading + 16 mΩ 0.002 % of reading + 0.16 Ω 0.002 % of reading + 1.6 Ω 0.002 8 % of reading + 24 Ω 0.034 % of reading + 2 kΩ 0.32 % of reading + 78 kΩ	Comparison to Fluke 5560A Multiproduct Calibrator (4-wire Configuration)
DC Resistance – Source ¹ (Fixed Artifacts)	1 mΩ 10 mΩ 100 mΩ 1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ	0.07 % of reading 0.07 % of reading 0.07 % of reading 0.012 % of reading 0.023 % of reading 0.009 % of reading 0.007 % of reading 0.006 % of reading 0.003 % of reading 0.005 % of reading	Comparison to Standard Resistors
DC Resistance – Source ¹ (Variable Artifact)	(100 to 1 000) kΩ (1 to 10) MΩ (10 to 100) MΩ (100 to 1 000) MΩ (1 to 10) GΩ (10 to 100) GΩ (100 to 1 000) GΩ	0.037% of reading 0.037 % of reading + 1.2 μΩ/Ω/V 0.12 % of reading + 1.2 μΩ/Ω/V 0.23 % of reading + 1.2 μΩ/Ω/V 0.59 % of reading + 1.2 μΩ/Ω/V 1.2 % of reading + 1.2 μΩ/Ω/V 1.2 % of reading + 1.2 μΩ/Ω/V	Comparison to High Accuracy Decade Resistor

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source ¹ (Simulation)	Up to 1.2 nF		Comparison to Fluke 5560A Multiproduct Calibrator
	(20 to 40) Hz	0.87 % of reading + 1.6 pF	
	(40 to 100) Hz	0.49 % of reading + 1.6 pF	
	100 Hz to 10 kHz	0.094 % of reading + 1.6 pF	
	(10 to 12) kHz	0.48 % of reading + 1.6 pF	
	(12 to 14) kHz	0.87 % of reading + 1.6 pF	
	(1.2 to 3) nF		
	(10 to 150) Hz	0.49 % of reading + 3.9 pF	
	150 Hz to 5 kHz	0.09 % of reading + 3.9 pF	
	(5 to 6) kHz	0.48 % of reading + 3.9 pF	
	(6 to 8) kHz	0.87 % of reading + 3.9 pF	
	(3 to 12) nF		
	10 Hz to 5 kHz	0.09 % of reading + 3.9 pF	
	(5 to 6) kHz	0.48 % of reading + 3.9 pF	
	(6 to 8) kHz	0.87 % of reading + 3.9 pF	
	(12 to 30) nF		
	(20 to 200) Hz	0.49 % of reading + 24 pF	
	200 Hz to 1.3 kHz	0.1 % of reading + 24 pF	
	(1.3 to 2.7) kHz	0.49 % of reading + 24 pF	
	(2.7 to 3.7) kHz	0.88 % of reading + 24 pF	
	(30 to 120) nF		
	10 Hz to 1.3 kHz	0.1 % of reading + 24 pF	
	(1.3 to 2.7) kHz	0.49 % of reading + 24 pF	
	(2.7 to 3.7) kHz	0.88 % of reading + 24 pF	
(0.12 to 1.2) μF			
(2 to 310) Hz	0.1 % of reading + 0.24 nF		
(310 to 800) Hz	0.49 % of reading + 0.24 nF		
800 Hz to 1.1 kHz	0.88 % of reading + 0.24 nF		
(1.2 to 12) μF			
500 mHz to 110 Hz	0.1 % of reading + 2.4 nF		
(110 to 250) Hz	0.49 % of reading + 2.4 nF		
(250 to 350) Hz	0.88 % of reading + 2.4 nF		
(12 to 120) μF			
(100 to 500) mHz	0.5 % of reading + 20 nF		
500 mHz to 40 Hz	0.12 % of reading + 20 nF		
(40 to 80) Hz	0.5 % of reading + 20 nF		
(80 to 110) Hz	0.89 % of reading + 20 nF		

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source ¹ (Simulation)	(0.12 to 1.2) mF 100 mHz to 11 Hz (11 to 18) Hz (18 to 25) Hz	0.2 % of reading + 0.2 μF 0.58 % of reading + 0.2 μF 1 % of reading + 0.2 μF	Comparison to Fluke 5560A Multiproduct Calibrator
	(1.2 to 12) mF 30 mHz to 4 Hz (4 to 6) Hz (6 to 8) Hz	0.19 % of reading + 2.4 μF 0.58 % of reading + 2.4 μF 1 % of reading + 2.4 μF	
	(12 to 120) mF 10 mHz to 1.3 Hz (1.3 to 1.7) Hz (1.7 to 2.5) Hz	0.39 % of reading + 24 μF 0.78 % of reading + 24 μF 1.2 % of reading + 24 μF	
Capacitance – Measure ¹	1 kHz 1 pF to 1 nF (1 to 10) nF (10 to 100) nF (0.1 to 1) μF (1 to 10) μF (10 to 100) μF (0.1 to 1) mF (1 to 10) mF (10 to 100) mF	1.9 % of reading + 19 pF 0.83 % of reading + 39 pF 0.83 % of reading + 0.39 nF 0.83 % of reading + 3.9 nF 0.82 % of reading + 39 nF 0.9 % of reading + 0.39 μF 0.89 % of reading + 3.9 μF 0.89 % of reading + 39 μF 3.2 % of reading + 0.16 mF	Comparison to Fluke 8846A 6.5 Digit Multimeter
Inductance – Source ¹ (Simulation)	Up to 120 μH (490 to 550) Hz 550 Hz to 1 kHz 1 kHz (1 to 13) kHz (13 to 17) kHz (0.12 to 1.2) mH (260 to 330) Hz 330 Hz to 1 kHz 1 kHz (1 to 1.6) kHz (1.6 to 2.5) kHz (1.2 to 3.3) mH 500 mHz to 110 Hz 110 Hz (110 to 800) Hz (800 to 980) Hz	0.93 % of reading + 0.16 μH 0.35 % of reading + 0.16 μH 0.16 % of reading + 0.16 μH 0.35 % of reading + 0.16 μH 0.93 % of reading + 0.16 μH 0.87 % of reading + 0.78 μH 0.29 % of reading + 0.78 μH 0.094 % of reading + 0.78 μH 0.29 % of reading + 0.78 μH 0.87 % of reading + 0.78 μH 0.3 % of reading + 7.8 μH 0.094 % of reading + 7.8 μH 0.29 % of reading + 7.8 μH 0.87 % of reading + 7.8 μH	Comparison to Fluke 5560A Multiproduct Calibrator



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Inductance – Source ¹ (Simulation)	(3.3 to 12) mH		Comparison to Fluke 5560A Multiproduct Calibrator
	500 mHz to 110 Hz	0.29 % of reading + 7.8 μH	
	110 Hz	0.093 % of reading + 7.8 μH	
	110 Hz to 1 kHz	0.29 % of reading + 7.8 μH	
	(1 to 1.4) kHz	0.87 % of reading + 7.8 μH	
	(12 to 83) mH		
	100 mHz to 100 Hz	0.29 % of reading + 78 μH	
	100 Hz	0.093 % of reading + 78 μH	
	(100 to 180) Hz	0.29 % of reading + 78 μH	
	(180 to 230) Hz	0.87 % of reading + 78 μH	
	(83 to 120) mH		
	100 mHz to 100 Hz	0.29 % of reading + 78 μH	
	100 Hz	0.093 % of reading + 78 μH	
	(100 to 320) Hz	0.3 % of reading + 78 μH	
	320 Hz to 1 kHz	0.87 % of reading + 78 μH	
	(120 to 650) mH		
	50 mHz to 10 Hz	0.32 % of reading + 0.78 mH	
	10 Hz	0.14 % of reading + 0.78 mH	
	(10 to 30) Hz	0.32 % of reading + 0.78 mH	
	(30 to 55) Hz	0.9 % of reading + 0.78 mH	
	(0.65 to 1.2) H		
	50 mHz to 10 Hz	0.32 % of reading + 0.78 mH	
	10 Hz	0.14 % of reading + 0.78 mH	
	(10 to 100) Hz	0.32 % of reading + 0.78 mH	
	(100 to 170) Hz	0.9 % of reading + 0.78 mH	
	(1.2 to 5.5) H		
	10 mHz to 3 Hz	0.36 % of reading + 7.8 mH	
	3 Hz	0.17 % of reading + 7.8 mH	
	(3 to 8) Hz	0.36 % of reading + 7.8 mH	
	(8 to 16) Hz	0.93 % of reading + 7.8 mH	
(5.5 to 12) H			
10 mHz to 3 Hz	0.36 % of reading + 7.8 mH		
3 Hz	0.17 % of reading + 7.8 mH		
(3 to 19) Hz	0.36 % of reading + 7.8 mH		
(19 to 37) Hz	0.93 % of reading + 7.8 mH		
(12 to 30) H			
5 mHz to 2 Hz	0.39 % of reading + 78 mH		
2 Hz	0.21 % of reading + 78 mH		
(2 to 4) Hz	0.39 % of reading + 78 mH		
(4 to 9) Hz	1 % of reading + 78 mH		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Inductance – Source ¹ (Simulation)	(30 to 120) H 5 mHz to 2 Hz 2 Hz (2 to 7) Hz (7 to 14) Hz	0.39 % of reading + 78 mH 0.21 % of reading + 78 mH 0.39 % of reading + 78 mH 1 % of reading + 78 mH	Comparison to Fluke 5560A Multiproduct Calibrator
Inductance – Source ¹ (Fixed Artifacts)	50 μH 100 μH 200 μH 500 μH 1 mH 5 mH 20 mH 50 mH	0.6 % of reading 0.6 % of reading 0.6 % of reading 0.6 % of reading 0.6 % of reading 0.6 % of reading 0.6 % of reading 0.6 % of reading	Comparison to General Radio Standard Inductors
LF Phase – Source ¹	(0 to 180)° (10 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 20) kHz	0.11° 0.21° 0.39° 1.9° 3.9° 7.8°	Comparison to Fluke 5522A Multiproduct Calibrator
Electrical Simulation of RTD Indicating Devices – Source ¹	Pt 385, 100 Ω (-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C Pt 385, 200 Ω (-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.039 °C 0.039 °C 0.054 °C 0.070 °C 0.078 °C 0.093 °C 0.18 °C 0.031 °C 0.031 °C 0.031 °C 0.039 °C 0.093 °C 0.1 °C 0.11 °C 0.12 °C	Comparison to Fluke 5560A 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, 500 Ω		Comparison to Fluke 5560A Multiproduct Calibrator
	(-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, 1 000 Ω		
	(-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	
	Pt 3916, 100 Ω		
	(-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		
Ni 672, 120 Ω			
(-80 to 0) °C	0.06 °C		
(0 to 100) °C	0.06 °C		
(100 to 260) °C	0.11 °C		



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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	Cu 427, 10 Ω (-80 to 260) °C	0.23 °C	Comparison to Fluke 5560A Multiproduct Calibrator
	Cu 428, 50 Ω (-180 to 200) °C	0.31 °C	
	Cu 428, 100 Ω (-180 to 40) °C (40 to 200) °C	0.31 °C 0.5 °C	
Electrical Simulation of Thermocouple Indicating Devices – Source/Measure ¹	Type B (250 to 350) °C	1.2 °C	Comparison to Ectron 1140A Thermocouple Calibrator/Simulator
	(350 to 445) °C	0.9 °C	
	(445 to 580) °C	0.71 °C	
	(580 to 750) °C	0.55 °C	
	(750 to 1 000) °C	0.45 °C	
	(1 000 to 1 820) °C	0.35 °C	
	Type E (-270 to -245) °C	1.6 °C	
	(-245 to -195) °C	0.24 °C	
	(-195 to -155) °C	0.12 °C	
	(-155 to -90) °C	0.095 °C	
	(-90 to 0) °C	0.08 °C	
	(0 to 15) °C	0.076 °C	
	(15 to 890) °C	0.064 °C	
	(890 to 1 000) °C	0.074 °C	
	Type J (-210 to -180) °C	0.15 °C	
	(-180 to -120) °C	0.12 °C	
	(-120 to -50) °C	0.093 °C	
	(-50 to 990) °C	0.08 °C	
	(990 to 1 200) °C	0.094 °C	
	Type K (-270 to -255) °C	2.5 °C	
(-255 to -195) °C	0.85 °C		
(-195 to -115) °C	0.16 °C		
(-115 to -55) °C	0.12 °C		
(-55 to 1 000) °C	0.087 °C		
(1 000 to 1 372) °C	0.096 °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 N		Comparison to Ectron 1140A Thermocouple Calibrator/Simulator
	(-270 to -260) °C	5.4 °C	
	(-260 to -200) °C	1.5 °C	
	(-200 to -140) °C	0.29 °C	
	(-140 to -70) °C	0.18 °C	
	(-70 to 25) °C	0.14 °C	
	(25 to 160) °C	0.12 °C	
	(160 to 1 300) °C	0.11 °C	
	Type R		
	(-50 to -30) °C	0.8 °C	
	(-30 to 45) °C	0.69 °C	
	(45 to 160) °C	0.49 °C	
	(160 to 380) °C	0.35 °C	
	(380 to 775) °C	0.3 °C	
	(775 to 1 768) °C	0.26 °C	
	Type S		
	(-50 to -30) °C	0.76 °C	
	(-30 to 45) °C	0.68 °C	
	(45 to 105) °C	0.49 °C	
	(105 to 310) °C	0.41 °C	
(310 to 615) °C	0.35 °C		
(615 to 1 768) °C	0.31 °C		
Type T			
(-270 to -255) °C	1.9 °C		
(-255 to -240) °C	0.6 °C		
(-240 to -210) °C	0.36 °C		
(-210 to -150) °C	0.22 °C		
(-150 to -40) °C	0.15 °C		
(-40 to 100) °C	0.095 °C		
(100 to 400) °C	0.08 °C		
Electrical Simulation of Thermocouple Indicating Devices – Source/Measure ¹	Type C		Comparison to Fluke 5560A Multiproduct Calibrator
	(0 to 150) °C	0.19 °C	
	(150 to 650) °C	0.16 °C	
	(650 to 1 000) °C	0.2 °C	
	(1 000 to 1 800) °C	0.35 °C	
	(1 800 to 2 315) °C	0.61 °C	



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices – Source/Measure ¹	Type D (0 to 150) °C	0.19 °C	Comparison to Fluke 5560A Multiproduct Calibrator
	(150 to 650) °C	0.16 °C	
	(650 to 1 000) °C	0.2 °C	
	(1 000 to 1 800) °C	0.34 °C	
	(1 800 to 2 315) °C	0.61 °C	
	Type G (0 to 150) °C	0.39 °C	
	(150 to 650) °C	0.26 °C	
	(650 to 1 000) °C	0.2 °C	
	(1 000 to 1 800) °C	0.33 °C	
	(1 800 to 2 315) °C	0.6 °C	
	Type L (-200 to -100) °C	0.24 °C	
	(-100 to 800) °C	0.16 °C	
	(800 to 900) °C	0.09 °C	
	Type U (-200 to 0) °C	0.31 °C	
(0 to 600) °C	0.09 °C		
Type BP (0 to 1 000) °C	0.31 °C		
(1 000 to 2 000) °C	0.47 °C		
(2 000 to 2 500) °C	0.62 °C		
Type XK (-200 to 300) °C	0.16 °C		
(300 to 800) °C	0.23 °C		
Oscilloscopes ^{1,6} Amplitude – DC into 50 Ω load into 1 MΩ load	(-6.6 to 6.6) V (-130 to 130) V	0.22 % of reading + 31 μV 0.12 % of reading + 31 μV	Comparison to Fluke 55xx/11 Multiproduct Calibrator with 1.1 GHz Scope Option
Amplitude – Square Wave into 50 Ω load	1 mVp-p to 6.6 Vp-p 10 Hz to 10 kHz	0.22 % of reading + 31 μV	
into 1 MΩ load	1 mVp-p to 130 Vp-p 10 Hz to 1 kHz	0.14 % of reading + 31 μV	
	(1 to 10 kHz)	0.22 % of reading + 31 μV	



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes ^{1,6} Time Markers into 50 Ω load	1 ns to 20 ms 50 ms 100 ms 200 ms 500 ms 1 s 2 s 5 s	0.000 22 % of reading 0.005 9 % of reading 0.009 8 % of reading 0.018 % of reading 0.041 % of reading 0.08 % of reading 0.16 % of reading 0.39 % of reading	Comparison to Fluke 55xx/11 Multiproduct Calibrator with 1.1 GHz Scope Option
Rise Time into 50 Ω Load Rate: 1 kHz to 2 MHz Rate: 2 MHz to 10 MHz	5 mVp-p to 2.5 Vp-p (200 to 300) ps 50 ps 250 to 350 ps 50 ps	50 ps 50 ps	
Level Sine Wave into 50 Ω load	5 mVp-p to 5.5 Vp-p 50 kHz 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz 5 mVp-p to 3.5 Vp-p 600 MHz to 1.1 GHz	1.8 % of reading + 0.23 mV 2.8 % of reading + 0.23 mV 3.2 % of reading + 0.23 mV 4 % of reading + 0.23 mV 5.5 % of reading + 0.23 mV	
Bandwidth Flatness (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 5 mVp-p to 3.5 Vp-p 600 MHz to 1.1 GHz	1.4 % of reading + 78 μV 1.8 % of reading + 78 μV 3.2 % of reading + 78 μV 4 % of reading + 78 μV	
Input Impedance Measure	(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	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes ^{1,6} Wave Generator (Sine, Square, Triangle) Amplitude into 50 Ω load into 1 MΩ load Frequency	1.8 mVp-p to 2.5 Vp-p 10 Hz to 10 kHz 1.8 mVp-p to 55 Vp-p 10 Hz to 10 kHz 10 Hz to 10 kHz	2.3 % of reading + 78 μV 2.3 % of reading + 78 μV 0.001 9 % of reading + 12 mHz	Comparison to Fluke 55xx/11 Multiproduct Calibrator with 1.1 GHz Scope Option
Electrical Conductivity Meters – Simulation (Fixed Points)	24.85 % IACS 29.73 % IACS 44.95 % IACS 58.67 % IACS	0.26 % IACS 0.34 % IACS 0.39 % IACS 0.47 % IACS	Comparison to Eddy Current Conductivity Standards

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Angle Measuring Devices ¹ (Hand-Held)	Up to 90°	0.016°	Comparison to Angle Blocks
Micrometers ^{1,4} (Outside, Inside, Depth)	Up to 1 in (1 to 4) in (4 to 9) in (9 to 37) in	(14 + 4L) μin (10 + 6L) μin (16 + 4L) μin (14 + 4L) μin	Comparisons to Gage Blocks
Anvil Flatness	Up to 1 in	3.4 μin	Comparison to Optical Flats
Calipers ^{1,4} (Outside, Inside, Depth, Step)	Up to 1 in (1 to 4) in (4 to 9) in (9 to 37) in	(14 + 4L) μin (10 + 6L) μin (16 + 4L) μin (14 + 4L) μin	Comparisons to Gage Blocks
Bore Gages ^{1,4}	Up to 12 in	(70 + 4L) μin	Comparison to Characterized Cylindrical Rings
Indicators ^{1,4} (Dial, Digital, Test, Snap)	Up to 1 in (1 to 6) in	(10 + 2L) μin (6 + 5L) μin	Comparisons to Gage Blocks, Surface Plate

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Gage Blocks ⁴	(0.01 to 1) in (1 to 4) in (4 to 7) in	5.8 μin (1.6 + 4.2L) μin (2.1 + 4.4L) μin	Comparison to Universal Length Measuring Machine, Master Gage Blocks
Spheres Diameter	Up to 1 in	17 μin	Comparison to Universal Length Measuring Machine
Single Axis Length Measurement ⁴ Outside Inside	Up to 1 in (1 to 7) in (0.04 to 1) in (1 to 2.5) in (2.5 to 7) in	(6 + 1L) μin (8 + 3.5L) μin (9 + 1L) μin (9 + 3L) μin (14 + 3L) μin	Comparison to Universal Length Measuring Machine
Single Axis Length Measurement ⁴ Outside	(7 to 10) in	(23 + 2.6L) μin	Comparison to Pratt & Whitney Supermicrometer [®]
Single Axis Length Measurement ⁴ Outside	(10 to 48) in	(37 + 4.1L) μin	Comparisons to Gage Amplifier with Probe, Gage Blocks, Surface Plate
Chamfer Gages ¹	Up to 2 in	52 μin	Comparison to Cylindrical Rings
Height Gages ^{1,4}	Up to 24 in	(30 + 2.7L) μin	Comparison to Gage Blocks, Surface Plate
Height Masters, Riser Blocks, Stands ^{1,4}	Up to 24 in	(35 + 2.7L) μin	Comparisons to Gage Amplifier with Probe, Surface Plate
Straightness (Size up to 72 in)	Up to 0.05 in	76 μin	Comparisons to Gage Amplifier with Probe, Surface Plate

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Optical Comparators ^{1,4} X-Y Length	(0.01 to 6) in	76 μin	Comparisons to Calibration Grids
Angle	15° 30° 45°	3.3" 3.3" 3.3"	Angle Blocks
Magnification	10X to 100X	0.002 3 in	Calibration Grids
Thread Wires	Up to 0.2 in	20 μin	Comparison to Universal Length Measuring Machine
Cylindrical Ring Gages ⁴ Inside Diameter	Up to 4 in (4 to 12) in	(3.9 + 3.8L) μin (9.5 + 5.5L) μin	Comparison to Universal Length Measuring Machine
Cylindrical Plug Gages ⁴ Outside Diameter	(0.01 to 1) in (1 to 2) in (2 to 3) in (3 to 4) in (4 to 5) in (5 to 6) in	5.1 μin 9.1 μin 13 μin 17 μin 21 μin 25 μin	Comparison to Universal Length Measuring Machine
Pin Gages Outside Diameter	(0.011 to 1) in	28 μin	Comparison to Pratt & Whitney Supermicrometer [®]
Measuring Tapes, Rulers ⁴	Up to 100 in (100 to 3 600) in	0.003 1 in (31L) μin	Comparison to Fowler Trimos Horizon Length Measuring Machine
Surface Plates ^{1,4} Overall Flatness	(12 to 240) inDL	2√DL μin	In accordance with ASME B89.3.7 using Laser Interferometer
Local Area Flatness (Repeat Readings)	Up to 0.001 in	38 μin	Repeat-o-Meter

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Thread Plug Gages ⁴ Pitch Diameter	(0.0625 to 10) in	(120 + 4L) μin	Comparison to Pratt & Whitney Supermicrometer [®] , Master Thread Wires
Major Diameter	(0.0625 to 10) in	18 μin	Pratt & Whitney Supermicrometer [®]
Step Height	Up to 1 in	51 μin	Height Gage
Tapered Plug Gages ⁴ Pitch Diameter	(0.0625 to 10) in	(120 + 4L) μin	Comparisons to Pratt & Whitney Supermicrometer [®] , Master Thread Wires
Standoff	Up to 1 in	51 μin	Gage Amplifier with Probe, Surface Plate
Radius Gages	Up to 1 in	260 μin	Comparisons to Optical Comparator
Feeler Gages, Thickness Gages	(0.001 5 to 0.25) in	24 μin	Comparisons to Pratt & Whitney Supermicrometer [®]
Coating Thickness Testers	Up to 0.06 in	1.1 % of reading + 2.2 μin	Comparison to Master Films
Coating Thickness Standards	(0.001 to 0.01) in	4.7 μin	Comparison to Universal Length Measuring Machine
Coating Thickness Standards	(0.01 to 0.36) in	28 μin	Comparison to Pratt & Whitney Supermicrometer [®]
Sine Plates/Bars ⁴ (Up to 15 in)			
Flatness	Up to 0.05 in	9.6 μin	Comparison to Gage Amplifier with Probe, Surface Plate
Parallelism	Up to 0.05 in	51 μin	
Angle	Up to 45°	7.8"	
Riser Blocks/Stands ⁴	Up to 24 in	(35 + 2.7L) μin	Comparison to Gage Amplifier with Probe, Surface Plate

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Parallels Steel (Up to 1.5 in x 6 in) Granite (Up to 8 in x 48 in)	Up to 0.05 in Up to 0.05 in	43 μin 43 μin	Comparison to Gage Amplifier with Probe, Surface Plate
V-Blocks (Up to 8 in x 8 in x 8 in) Parallelism V Center Squareness & Parallelism Squareness of Block	Up to 0.05 in Up to 0.05 in Up to 0.05 in	51 μin 39 μin 56 μin	Comparisons to Gage Amplifier with Probe, Surface Plate, Master Setting Disks
Microscope Reticule	Up to 6 in	76 μin	Comparison to Glass Scale
Bench Micrometers ⁴	Up to 10 in	(9 + 4L) μin	Comparison to Gage Blocks, Long Gage Blocks
Coordinate Measuring Machines ^{1,4} Linear Displacement Squareness Volumetric Repeatability	Up to 20 in Up to 18 in Up to 72 in	(7 + 1.3L) μin 43 μin 160 μin	Comparisons to Laser Interferometer Granite Square Ball Bar
Articulating Arm Coordinate Measuring Machine ⁴ Effective Diameter Single Point Articulation Volumetric Performance	(10 to 50) mm - Up to 65 in	0.43 μm 11 μin (90 + 5L) μin	Comparisons to CMM Sphere Conical Socket Ball Bar Kit
Distance Measuring Equipment ⁴	Up to 99 999 ft	(0.05 + 0.000 5X) ft	Comparison to Cylinder with Square Ends with Incremental Counter



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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Gas Flow Measuring Devices ¹	Up to 20 sccm (40 to 100) sccm (200 to 500) sccm (0.5 to 2) slpm (4 to 20) slpm (40 to 100) slpm (100 to 500) slpm	0.75 % of reading + 0.04 sccm 0.75 % of reading + 0.2 sccm 0.75 % of reading + 1 sccm 0.75 % of reading + 0.004 slpm 0.75 % of reading + 0.04 slpm 0.75 % of reading + 0.2 slpm 0.75 % of reading + 1 slpm	Comparison to Reference Flow Meters; Referenced to Standard Atmospheric Conditions
Absolute Pressure Measuring Devices ¹ (Pneumatic)	(0 to 14.7) psia (14.7 to 39.7) psia (39.7 to 514.7) psia	0.002 5 psi 0.000 71% of reading + 0.002 3 psi 0.006 5 % of reading	Comparison to Pneumatic Pressure Controller/Calibrator
Gauge Pressure Measuring Devices ¹ (Pneumatic)	(-14.2 to < 0) psig Up to 25 psig (25 to 500) psig (-36 to -22) inH ₂ O (-22 to 22) inH ₂ O (22 to 60) inH ₂ O (60 to 72) inH ₂ O (72 to 804) inH ₂ O	0.000 64 % of reading + 0.001 3 psi 0.001 4 % of reading + 0.001 3 psi 0.006 7 % of reading 0.009 % of reading + 0.000 15 inH ₂ O 0.002 inH ₂ O 0.009 % of reading + 0.000 15 inH ₂ O 0.006 5 inH ₂ O 0.009 % of reading + 0.000 15 inH ₂ O	Comparison to Pneumatic Pressure Controller/Calibrator
Gauge Pressure Measuring Devices ¹ (Pneumatic)	(10 to 1 000) psig	0.011 % of reading + 0.000 1 psi	Comparison to Deadweight Tester
Gauge Pressure Measuring Devices, Pressure Controllers/Calibrators ¹ (Hydraulic)	Up to 150 psig (150 to 1 500) psig (50 to 1 500) psig (1 500 to 15 000) psig	0.032 psi 0.008 % of reading + 0.02 psi 0.14 psi 0.008 % of reading + 0.02 psi	Comparison to Deadweight Tester
Scales and Balances ^{1,5} (SI)	Up to 500 mg (0.5 to 5) g (5 to 10) g (10 to 20) g (0.02 to 40) kg (40 to 50) kg	12 µg 40 µg 60 µg 90 µg 0.000 31 % of reading 0.000 28 % of reading	ASTM E617 Class 1 weights and internal calibration procedure utilized for the calibration of the weighing system.
Scales and Balances ^{1,5} (Avoirdupois)	Up to 1 lb (1 to 5) lb (5 to 1 000) lb	0.026 % of reading 0.018 % of reading 0.012 % of reading	NIST Class F Weights and internal calibration procedure utilized for the calibration of the weighing system.

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Mass Determination	(10 to 500) mg (1 to 10) g (20 to 40) g 50 g (100 to 200) g (300 to 500) g (1 to 3) kg 5 kg (10 to 35) kg	29 µg 36 µg 50 µg 0.27 mg 0.3 mg 5.9 mg 6.1 mg 6.6 mg 0.8 g	Comparison to Reference Weights, Balances
Rockwell Hardness and Superficial Testers ¹	HRA Scale (45 to 55) HRA (70 to 80) HRA (80 to 88) HRA HRBw Scale (44 to 49) HRBw (73 to 79) HRBw (88 to 99) HRBw HRC Scale (24 to 28) HRC (42 to 47) HRC (60 to 65) HRC HREw Scale (69 to 76) HREw (83 to 91) HREw (96 to 100) HREw HRHw Scale (90 to 94) HRHw (96 to 100) HRHw HR15N Scale (70 to 77) HR15N (78 to 88) HR15N (90 to 92) HR15N HR15TW Scale (72 to 75) HR15TW (82 to 86) HR15TW (90 to 92) HR15TW	0.37 HRA 0.21 HRA 0.21 HRA 0.62 HRBw 0.46 HRBw 0.59 HRBw 0.46 HRC 0.55 HRC 0.21 HRC 0.35 HREw 0.51 HREw 0.35 HREw 0.37 HRHw 0.25 HRHw 0.38 HR15N 0.42 HR15N 0.29 HR15N 0.77 HR15TW 0.44 HR15TW 0.3 HR15TW	Indirect verification per ASTM E18, ASTM E110 using Hardness Test Blocks.



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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	HR30N Scale (45 to 48) HR30N (65 to 68) HR30N (76 to 78) HR30N HR30TW Scale (48 to 53) HR30TW (59 to 63) HR30TW (72 to 81) HR30TW HR45N Scale (20 to 31) HR45N (37 to 61) HR45N (66 to 72) HR45N HR45TW Scale (25 to 30) HR45TW (43 to 49) HR45TW (61 to 64) HR45TW	0.35 HR30N 0.68 HR30N 0.33 HR30N 0.66 HR30TW 0.47 HR30TW 0.31 HR30TW 0.65 HR45N 0.42 HR45N 0.47 HR45N 0.51 HR45TW 0.32 HR45TW 0.37 HR45TW	Indirect verification per ASTM E18, ASTM E110 using Hardness Test Blocks
Brinell Hardness Testers ¹	HBW 10/500/15 Scale (16 to 62) HBW (63 to 109) HBW HBW 10/3000/15 Scale (100 to 350) HBW (351 to 650) HBW	2.1 HBW 3.4 HBW 6.5 HBW 21 HBW	Indirect verification per ASTM E10, ASTM E110 using Hardness Test Blocks.
Knoop Hardness Testers ¹	HK Scale (250 to 650) HK > 650 HK	14 HK 28 HK	Indirect verification per ASTM E92 using Hardness Test Blocks.
Vickers Hardness Testers ¹	HV Scale 300 HV 500 HV	59 HV 17 HV	Indirect verification per ASTM E92 using Hardness Test Blocks.
Durometers (Types A, D) Indenter Dimensions Diameter Angle Extension Indenter Display Spring Force	(0.028 to 0.055) in (25 to 40)° (0.095 to 0.105) mm (0 to 0.105) mm (0 to 100) Duro	180 µm 0.094° 0.25 µm 0.25 µm 0.4 Duro	Direct verification per ASTM D2240 using Multi-Axis Vision System Gage Blocks Durometer Calibrator



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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Force Measuring Equipment ¹ (Tension and Compression)	Up to 10 lbf (10 to 50) lbf (50 to 100) lbf (100 to 500) lbf	0.001 lbf 0.0017 lbf 0.008 lbf 0.07 lbf	Comparison to NIST Class F Weights
Force Measuring Equipment ¹ (Tension and Compression)	(500 to 2 000) lbf (2 000 to 5 000) lbf (5 000 to 10 000) lbf (10 000 to 30 000) lbf (50 000 to 100 000) lbf	2.5 lbf 6.2 lbf 13 lbf 22 lbf 71 lbf	Comparison to Reference Load Cells
Torque Tools ¹	(1 to 10) lbf·in	1.2 % of reading	Comparison to AWS-3000 Torque Analyzer
Torque Tools ¹	10 lbf·in to 2 000 lbf·ft	0.32 % of reading	Comparison to AKO Torque Transducers with Display
Viscosity ¹ (Dynamic)	(10 to 30 000) cP	0.8 % of reading	Comparison to Accredited Viscosity Solutions, Thermometer

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Humidity – Measure ¹	(15 to 25) °C Up to 95 %RH	1.2 %RH	Comparison to Rotronic HP23-A/HC2-S Temp/Humidity Indicator/Probe
Temperature – Measure ¹	(-195 to 0) °C (0 to 160) °C (160 to 420) °C (420 to 660) °C	0.015 °C 0.015 °C 0.02 °C 0.032 °C	Comparison to SPRT, Digital Temperature Indicator
Temperature – Source ¹ (Temp Measuring Devices)	(-50 to -30) °C	0.019 °C	Comparison to Liquid Bath, SPRT, Digital Temperature Indicator

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature – Source ¹ (Temp Measuring Devices)	(-30 to -20) °C	0.041 °C	Comparison to Micro-Bath, SPRT, Digital Temperature Indicator
Temperature – Source ¹ (Temp Measuring Devices)	(-20 to 25) °C (25 to 150) °C	0.018 °C 0.021 °C	Comparison to Liquid Bath, SPRT, Digital Temperature Indicator
Temperature – Source ¹ (Temp Measuring Devices)	(150 to 160) °C (160 to 300) °C (300 to 600) °C	0.061 °C 0.14 °C 0.52 °C	Comparison to Dry-well, SPRT, Digital Temperature Indicator
Infrared Thermometer ¹	(35 to 100) °C (100 to 120) °C (120 to 200) °C (200 to 350) °C (350 to 500) °C	0.67 °C 0.72 °C 0.97 °C 1.6 °C 2.2 °C	Comparison to Blackbody Source (flat plate) $\epsilon = (0.9 \text{ to } 1)$, $\lambda = (8 \text{ to } 14) \mu\text{m}$

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Reference	10 MHz	0.59 nHz/Hz	Comparison to Rubidium Frequency Standard
Frequency – Measure ¹	1 Hz to 10 kHz 10 kHz to 10 MHz (10 to 225) MHz	0.64 fHz/Hz + 4.5 μHz 0.64 fHz/Hz + 5 μHz 0.64 fHz/Hz	Comparison to Keysight 53132A Universal Counter, Rubidium Frequency Standard
Frequency – Measure ¹	225 MHz to 1 GHz	1.7 nHz/Hz	Comparison to Agilent 5386A, Frequency Counter, Rubidium Frequency Standard

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source ¹	1 Hz to 20 MHz	58 nHz/Hz	Comparison to Keysight 33220A Function Generator, Rubidium Frequency Standard
Frequency – Source ¹	20 MHz to 10 GHz	12 nHz/Hz	Comparison to HP 3325A Synthesize/Function Generator, GPS Frequency Standard
AC Duty Cycle – Source ¹ Square Wave: < 3.3 Vp-p Freq: 10 mHz to 100 kHz	(10 to 49) % Duty Cycle 10 μs to 100 s 50 % Duty Cycle 10 μs to 100 s (51 to 90) % Duty Cycle 10 μs to 100 s	0.039 % of reading + 78 ns 0.016 % of reading + 78 ns 0.039 % of reading + 78 ns	Comparison to Fluke 5560A Multiproduct Calibrator
Stopwatches, Timers ¹	(1 to 86 400) s	36 ms/d	Comparison to Agilent 5386A, Frequency Counter, Rubidium Frequency Standard
Tachometers – Optical Pickup ^{1,4}	Up to 999.99 rpm (1 000 to 5 000) rpm (5 000 to 60 000) rpm	0.004 rpm 0.009 rpm 0.23 rpm	Comparison to Fluke 5522A Multiproduct Calibrator, LED
Non-contact Rate of Rotation – Measure ^{1,4}	Up to 100 rpm (100 to 1 000) rpm (1 000 to 10 000) rpm (10 000 to 60 000) rpm	0.02 % of reading + 0.005 rpm 0.012 % of reading + 0.01 rpm 0.012 % of reading 0.01 % of reading	Comparison to Optical Tachometer

DIMENSIONAL MEASUREMENT

3 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Geometric Measurement of Fixtures, Gauges, Dies, and Molds	Up to 72 in	0.001 7 in	Faro Articulating Arm Coordinate Measuring Machine utilized as the reference standard for 3D 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 listed here are Nominal values. The actual certified values and associated Measurement Uncertainty will be utilized at the time of calibration.
3. 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.
4. L = length in inches; rpm = revolutions per minute; $''$ = arc-second; DL = diagonal length in inches; X = distance in feet.
5. 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.
6. The stated uncertainty is the laboratory's ability to source a fast rise pulse that is approximately 250 ps. In the typical application of measuring rise time of an oscilloscope, this value is one of the contributing factors, but other factors are derived from the DUT.
7. The legal entity for this client is Transcat, Inc.
8. Unless otherwise specified in the far-right column, the calibration procedure/method utilized was written internally.
9. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2489.13.



Jason Stine, Vice President