CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Transcat – Chesterfield
647 Trade Center Blvd.
Chesterfield, MO 63005

Fulfills the requirements of

ISO/IEC 17025:2017

and national standard

ANSI/NCSL Z540-1-1994 (R2002)

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-2489.32

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)

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CALIBRATION AND DIMENSIONAL MEASUREMENT

Valid to: **September 7, 2025** Certificate Number: **AC-2489.32**

CALIBRATION

Acoustics and Vibration

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

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH Meters [1,2]	4 pH 7 pH 10 pH	0.014 pH 0.015 pH 0.025 pH	Accredited pH Solutions
Conductivity Meters [1,2]	10 µS/cm 100 µS/cm 1 000 µS/cm 1 430 µS/cm	0.12 µS/cm 0.86 µS/cm 5.9 µS/cm 8.5 µS/cm	Accredited Conductivity Solutions

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure [1]	Up to 100 µA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz 100 µA 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 µA 0.17 % of reading + 0.23 µA 0.071 % of reading + 0.23 µA 0.038 % of reading + 0.23 µA 0.46 % of reading + 2.3 µA 0.17 % of reading + 2.3 µA 0.071 % of reading + 2.3 µA 0.038 % of reading + 2.3 µA 0.48 % of reading + 23 µA 0.17 % of reading + 23 µA 0.071 % of reading + 23 µA 0.037 % of reading + 23 µA 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	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	Fluke 8845A 6.5 Digit Multimeter
AC Current – Source [1]	Up to 120 µA (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 µA	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		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	
AC Clamp-on Meters [1] (Toroidal Type) Transformer Sensor	Up to 60 A		Fluke 5560A Multiproduct Calibrator, Fluke 5500A/COIL 50-turn Coil
	(45 to 440) Hz	0.5 % of reading + 2 mA	
	(60 to 155) A		
	(45 to 440) Hz	0.5 % of reading + 12 mA	

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 Sensor	(155 to 600) A (45 to 440) Hz (600 to 1 500) A (45 to 440) Hz	0.5 % of reading + 20 mA 0.51 % of reading + 0.31 A	Fluke 5560A Multiproduct Calibrator, Fluke 5500A/COIL 50-turn Coil
AC Current Clamp-on Meters [1] (Non-Toroidal Type) Hall-Effect Sensor	Up to 60 A (45 to 440) Hz (60 to 155) A (45 to 440) Hz (155 to 600) A (45 to 440) Hz (600 to 1 500) A (45 to 440) Hz	0.53 % of reading + 2 mA 0.53 % of reading + 12 mA 0.53 % of reading + 20 mA 0.53 % of reading + 0.31 A	Fluke 5560A Multiproduct Calibrator, Fluke 5500A/COIL 50-turn Coil
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 (9 to 33) mA (0.3 to 10) mW 10 mW to 33 W (33 to 90) mA (1 to 30) mW 30 mW to 90 W (90 to 330) mA (3 to 100) mW 100 mW to 300 W (0.33 to 0.9) A (11 to 300) mW 300 mW to 900 W (0.9 to 2.2) A 30 mW to 0.72 W 720 mW to 2 kW (2.2 to 4.5) A 80 mW to 1.4 W 1.4 W to 4.5 kW (4.5 to 20.5) A (0.15 to 6.7) W 6.7 W to 20 kW	0.13 % of reading 0.077 % of reading 0.089 % of reading 0.077 % of reading 0.071 % of reading 0.057 % of reading 0.089 % of reading 0.078 % of reading 0.071 % of reading 0.081 % of reading 0.089 % of reading 0.079 % of reading 0.088 % of reading 0.18 % of reading 0.17 % of reading 0.17 % of reading	Fluke 5522A Multiproduct Calibrator

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		Keysight 3458A Opt 002 8.5 Digit Multimeter
	(1 to 40) Hz	0.04 % of reading + 3.5 µV	
	40 Hz to 1 kHz	0.03 % of reading + 1.2 µV	
	(1 to 20) kHz	0.04 % of reading + 1.2 µV	
	(20 to 50) kHz	0.15 % of reading + 1.2 µV	
	(50 to 100) kHz	0.59 % of reading + 1.2 µV	
	(100 to 300) kHz	4.6 % of reading + 2.3 µV	
	300 kHz to 1 MHz	1.5 % of reading + 5.8 µV	
	(1 to 4) MHz	8.1 % of reading + 8.1 µV	
	(10 to 100) mV		
	(1 to 40) Hz	0.013 % of reading + 4.6 µV	
	40 Hz to 1 kHz	0.009 7 % of reading + 2.3 µV	
	(1 to 20) kHz	0.017 % of reading + 2.3 µV	
	(20 to 50) kHz	0.038 % of reading + 2.3 µV	
	(50 to 100) kHz	0.093 % of reading + 2.3 µV	
	(100 to 300) kHz	0.36 % of reading + 12 µV	
	300 kHz to 1 MHz	1.2 % of reading + 12 µV	
	(1 to 2) MHz	1.8 % of reading + 12 µV	
	(2 to 4) MHz	4.7 % of reading + 81 µV	
	(4 to 8) MHz	4.7 % of reading + 92 µV	
	(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 µV	
	40 Hz to 1 kHz	0.008 3 % of reading + 23 µV	
	(1 to 20) kHz	0.017 % of reading + 23 µV	
	(20 to 50) kHz	0.036 % of reading + 23 µV	
	(50 to 100) kHz	0.093 % of reading + 23 µV	
	(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	

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		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 10) kV		Vitrek 4700 Digital High Voltage Meter
	10 mHz to 10 Hz	0.16 % of reading + 0.69 V	
	(10 to 30) Hz	0.16 % of reading + 0.69 V	
	(30 to 50) Hz	0.15 % of reading + 0.69 V	
	(50 to 70) Hz	0.15 % of reading + 0.69 V	
	(70 to 100) Hz	0.15 % of reading + 0.69 V	
	(100 to 200) Hz	0.15 % of reading + 0.69 V	
	(200 to 450) Hz	0.48 % of reading + 0.69 V	
	(450 to 600) Hz	0.87 % of reading + 0.69 V	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source [1]	Up to 12 mV		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	
	(0.12 to 1.2) V		
	(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	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source [1]	(12 to 70) V		Fluke 5560A Multiproduct Calibrator
	(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 nV	
	(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	
	(330 to 1 020) V		
	(3 to 5) Hz	0.2 % of reading + 59 mV	
	(5 to 10) Hz	0.068 % of reading + 59 mV	
	10 Hz to 10 kHz	0.011 % of reading + 63 mV	
DC Current – Measure [1]	Up to 100 µA	0.003 3 % of reading + 0.92 nA	Keysight 3458A Opt 002 8.5 Digit Multimeter
	(0.1 to 1) mA	0.002 9 % of reading + 5.8 nA	
	(1 to 10) mA	0.002 9 % of reading + 58 nA	
	(10 to 100) mA	0.004 6 % of reading + 0.58 µA	
	(0.1 to 1) A	0.013 % of reading + 12 µA	
DC Current – Measure [1]	(1 to 3) A	0.13 % of reading	Fluke 8845A 6.5 Digit Multimeter
	(3 to 10) A	0.17 % of reading	
DC High Current – Measure [1]	(10 to 100) A	0.3 % of reading	Empro Current Shunt, Fluke 8845A 6.5 Digit Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Source [1]	Up to 120 µA (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 µA 0.013 % of reading + 7.8 µA 0.024 % of reading + 0.12 mA 0.024 % of reading + 0.2 mA 0.078 % of reading + 20 mA	Fluke 5560A Multiproduct Calibrator
DC Current Clamp-on Meters [1] (Non-Toroidal Type) Hall-Effect Sensor	Up to 60 A (60 to 155) A (155 to 600) A (600 to 1 500) A	0.59 % of reading + 3.9 mA 0.59 % of reading + 6 mA 0.59 % of reading + 9.5 mA 0.6 % of reading + 20 mA	Fluke 5560A Multiproduct Calibrator, Fluke 5500A/COIL 50-turn Coil
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	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	Keysight 3458A Opt 002 8.5 Digit Multimeter
DC High Voltage – Measure [1]	(1 to 10) kV	0.039 % of reading + 92 mV	Vitrek 4700 Digital High Voltage Meter
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	Fluke 5560A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Measure [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	0.001 8 % of reading + 58 µΩ 0.001 5 % of reading + 0.58 mΩ 0.001 3 % of reading + 0.58 mΩ 0.001 2 % of reading + 5.8 mΩ 0.001 3 % of reading + 58 mΩ 0.002 1 % of reading + 2.3 Ω 0.006 2 % of reading + 0.12 kΩ 0.059 % of reading + 1.2 kΩ 0.82 % of reading + 12 kΩ	Keysight 3458A Opt 002 8.5 Digit Multimeter
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	Fluke 5560A Multiproduct Calibrator (4-wire Mode)
Resistance – Source [1] (Fixed Artifacts)	0.001 Ω 0.01 Ω 0.1 Ω 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	Standard Resistors
Capacitance – Source [1] (Simulation)	Up to 1.2 nF (20 to 40) Hz (40 to 100) Hz 100 Hz to 10 kHz (10 to 12) kHz (12 to 14) kHz (1.2 to 3) nF (10 to 150) Hz 150 Hz to 5 kHz (5 to 6) kHz (6 to 8) kHz	 0.87 % of reading + 1.6 pF 0.49 % of reading + 1.6 pF 0.094 % of reading + 1.6 pF 0.48 % of reading + 1.6 pF 0.87 % of reading + 1.6 pF 0.49 % of reading + 3.9 pF 0.09 % of reading + 3.9 pF 0.48 % of reading + 3.9 pF 0.87 % of reading + 3.9 pF	Fluke 5560A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source [1] (Simulation)	(3 to 12) nF		Fluke 5560A Multiproduct Calibrator
	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	
	(0.12 to 1.2) mF		
	100 mHz to 11 Hz	0.2 % of reading + 0.2 µF	
	(11 to 18) Hz	0.58 % of reading + 0.2 µF	
	(18 to 25) Hz	1 % of reading + 0.2 µF	
	(1.2 to 12) mF		
	30 mHz to 4 Hz	0.19 % of reading + 2.4 µF	
	(4 to 6) Hz	0.58 % of reading + 2.4 µF	
	(6 to 8) Hz	1 % of reading + 2.4 µF	
	(12 to 120) mF		
	10 mHz to 1.3 Hz	0.39 % of reading + 24 µF	
	(1.3 to 1.7) Hz	0.78 % of reading + 24 µF	
	(1.7 to 2.5) Hz	1.2 % of reading + 24 µF	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Inductance – Source [1] (Simulation)	Up to 120 µH		Fluke 5560A Multiproduct Calibrator
	(490 to 550) Hz	0.93 % of reading + 0.16 µH	
	550 Hz to 1 kHz	0.35 % of reading + 0.16 µH	
	1 kHz	0.16 % of reading + 0.16 µH	
	(1 to 13) kHz	0.35 % of reading + 0.16 µH	
	(13 to 17) kHz	0.93 % of reading + 0.16 µH	
	(0.12 to 1.2) mH		
	(260 to 330) Hz	0.87 % of reading + 0.78 µH	
	330 Hz to 1 kHz	0.29 % of reading + 0.78 µH	
	1 kHz	0.094 % of reading + 0.78 µH	
	(1 to 1.6) kHz	0.29 % of reading + 0.78 µH	
	(1.6 to 2.5) kHz	0.87 % of reading + 0.78 µH	
	(1.2 to 3.3) mH		
	500 mHz to 110 Hz	0.3 % of reading + 7.8 µH	
	110 Hz	0.094 % of reading + 7.8 µH	
	(110 to 800) Hz	0.29 % of reading + 7.8 µH	
	(800 to 980) Hz	0.87 % of reading + 7.8 µH	
	(3.3 to 12) mH		
	500 mHz to 110 Hz	0.29 % of reading + 7.8 µH	
	110 Hz	0.093 % of reading + 7.8 µH	
	110 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	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Inductance – Source [1] (Simulation)	(1.2 to 5.5) H 10 mHz to 3 Hz 3 Hz (3 to 8) Hz (8 to 16) Hz (5.5 to 12) H (0.01 to 3) Hz 3 Hz (3 to 19) Hz (19 to 37) Hz (12 to 30) H (0.005 to 2) Hz 2 Hz (2 to 4) Hz (4 to 9) Hz (30 to 120) H (0.005 to 2) Hz 2 Hz (2 to 7) Hz (7 to 14) Hz	 0.36 % of reading + 7.8 mH 0.17 % of reading + 7.8 mH 0.36 % of reading + 7.8 mH 0.93 % of reading + 7.8 mH 0.36 % of reading + 7.8 mH 0.17 % of reading + 7.8 mH 0.36 % of reading + 7.8 mH 0.93 % of reading + 7.8 mH 0.39 % of reading + 78 mH 0.21 % of reading + 78 mH 0.39 % of reading + 78 mH 1 % of reading + 78 mH 0.39 % of reading + 78 mH 0.21 % of reading + 78 mH 0.39 % of reading + 78 mH 1 % of reading + 78 mH	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	General Radio Standard Inductors
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	 0.039 °C 0.039 °C 0.054 °C 0.07 °C 0.078 °C 0.093 °C 0.18 °C	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, 200 Ω		Fluke 5560A Multiproduct Calibrator
	(-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, 1 000 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	

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 3926, 100 Ω		Fluke 5560A 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	
	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	
	Cu 427, 10 Ω		
	(-80 to 260) °C	0.23 °C	
	Cu 428, 50 Ω		
	(-180 to 200) °C	0.31 °C	
	Cu 428, 100 Ω		
	(-180 to 40) °C	0.31 °C	
	(40 to 200) °C	0.5 °C	
Electrical Simulation of Thermocouple Indicating Devices – Source/Measure [1]	Type B		Fluke 5560A Multiproduct Calibrator
	(600 to 800) °C	0.34 °C	
	(800 to 1 000) °C	0.26 °C	
	(1 000 to 1 550) °C	0.23 °C	
	(1 550 to 1 820) °C	0.26 °C	
	Type C		
	(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	
	Type D		
	(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	0.34 °C	
	(1 800 to 2 315) °C	0.61 °C	
	Type E		
	(-250 to -150) °C	0.31 °C	
	(-150 to -25) °C	0.11 °C	
	(-25 to 350) °C	0.09 °C	
	(350 to 650) °C	0.12 °C	
	(650 to 1 000) °C	0.16 °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 G		Fluke 5560A Multiproduct Calibrator
	(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 J		
	(-210 to -100) °C	0.19 °C	
	(-100 to -30) °C	0.1 °C	
	(-30 to 150) °C	0.09 °C	
	(150 to 760) °C	0.11 °C	
	(760 to 1 200) °C	0.16 °C	
	Type K		
	(-200 to -100) °C	0.22 °C	
	(-100 to -25) °C	0.1 °C	
	(-25 to 120) °C	0.09 °C	
	(120 to 1 000) °C	0.16 °C	
	(1 000 to 1 372) °C	0.27 °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 N		
	(-200 to -100) °C	0.26 °C	
	(-100 to -25) °C	0.12 °C	
	(-25 to 120) °C	0.09 °C	
	(120 to 410) °C	0.09 °C	
	(410 to 1 300) °C	0.16 °C	
	Type R		
	(0 to 250) °C	0.4 °C	
	(250 to 400) °C	0.23 °C	
	(400 to 1 000) °C	0.21 °C	
	(1 000 to 1 767) °C	0.26 °C	
	Type S		
	(0 to 250) °C	0.33 °C	
	(250 to 400) °C	0.24 °C	
	(400 to 1 000) °C	0.25 °C	
	(1 000 to 1 767) °C	0.32 °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 T (-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C Type U (-200 to 0) °C (0 to 600) °C Type BP (0 to 1 000) °C (1 000 to 2 000) °C (2 000 to 2 500) °C Type XK (-200 to 300) °C (300 to 800) °C	 0.47 °C 0.16 °C 0.1 °C 0.09 °C 0.31 °C 0.09 °C 0.31 °C 0.47 °C 0.62 °C 0.16 °C 0.23 °C	Fluke 5560A Multiproduct Calibrator
Oscilloscopes [1] Amplitude – DC into 50 Ω load into 1 MΩ load Amplitude – Square Wave into 50 Ω load into 1 MΩ load Time Markers into 50 Ω load Rise Time into 50 Ω load Rate: 1 kHz to 2 MHz Rate: (2 to 10) MHz	 (-6.6 to 6.6) V (-130 to 130) V 1 mVp-p to 6.6 Vp-p 10 Hz to 10 kHz 1 mVp-p to 130 Vp-p 10 Hz to 1 kHz (1 to 10) kHz 1 nS to 20 mS 50 ms 100 ms 200 ms 500 ms 1 s 2 s 5 s 5 mVp-p to 2.5 Vp-p (200 to 300) ps (250 to 350) ps	 0.22 % of reading + 31 µV 0.12 % of reading + 31 µV 0.22 % of reading + 31 µV 0.14 % of reading + 31 µV 0.22 % of reading + 31 µV 0.000 22 % of reading 0.005 9 % of reading 0.009 8 % of reading 0.018 % of reading 0.041 % of reading 0.080 % of reading 0.16 % of reading 0.39 % of reading 50 ps 50 ps	Fluke 5522A/11 Multiproduct Calibrator with 1.1 GHz Scope Option

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes [1]			Fluke 5522A/11 Multiproduct Calibrator with 1.1 GHz Scope Option
Level Sine Wave			
into 50 Ω load	5 mVp-p to 5.5 Vp-p		
	50 kHz	1.8 % of reading + 0.23 mV	
	50 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	
Bandwidth Flatness (50 kHz Reference)			
into 50 Ω load	5 mVp-p to 5.5 Vp-p		
	50 kHz to 100 MHz	1.4 % of reading + 78 µV	
	(100 to 300) MHz	1.8 % of reading + 78 µV	
	(300 to 600) MHz	3.2 % of reading + 78 µV	
	5 mVp-p to 3.5 Vp-p		
	600 MHz to 1.1 GHz	4 % of reading + 78 µV	
Input Impedance Measure	(40 to 60) Ω	0.082 % of reading	
	(0.5 to 1.5) MΩ	0.081 % of reading	
Input Capacitance Measure	(5 to 50) pF	3.9 % of reading + 0.39 pF	
Wave Generator (Sine, Square, Triangle)			
Amplitude			
into 50 Ω load	1.8 mVp-p to 2.5 Vp-p		
	10 Hz to 10 kHz	2.3 % of reading + 78 µV	
into 1 MΩ load	1.8 mVp-p to 55 Vp-p		
	10 Hz to 10 kHz	2.3 % of reading + 78 µV	
Frequency	10 Hz to 10 kHz	0.001 9 % of reading + 12 mHz	
Electrical Conductivity Meters (Fixed Points)	24.85 %IACS	0.26 %IACS	Eddy Current Conductivity Standards
	29.73 %IACS	0.34 %IACS	
	44.95 %IACS	0.39 %IACS	
	58.67 %IACS	0.47 %IACS	

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°	Angle Blocks
Machinist Levels	Up to 72 in	49 µin	Gage Blocks, Surface Plate
Calipers [1,4] (Outside, Inside, Depth)	Up to 1 in (1 to 4) in (4 to 9) in (9 to 37) in	(14 + 4*L*) µin (10 + 6*L*) µin (16 + 4*L*) µin (14 + 4*L*) µin	Gage Blocks, Long Gage Blocks
Outside Micrometers [1,4]	Up to 1 in (1 to 4) in (4 to 9) in (9 to 37) in	(14 + 4*L*) µin (10 + 6*L*) µin (16 + 4*L*) µin (14 + 4*L*) µin	Gage Blocks, Long Gage Blocks
Anvil Flatness [1]	Up to 1 in	3.4 µin	Optical Flats
Bore Gages [1,4]	Up to 12 in	(70 + 4*L*) µin	Characterized Cylindrical Rings
Indicators [1,4] (Dial, Digital, Test, Snap)	Up to 1 in (1 to 6) in	(10 + 2*L*) µin (6 + 5*L*) µin	Gage Blocks, Surface Plate
Gage Blocks [4]	(0.01 to 1) in (1 to 4) in (4 to 7) in	5.8 µin (1.6 + 4.2*L*) µin (2.1 + 4.4*L*) µin	Universal Length Measuring Machine, Master Gage Blocks
Sphere Diameter	Up to 1 in	17 µin	Universal Length Measuring Machine
Single Axis Length [4] Outside	Up to 1 in (1 to 7) in (7 to 10) in (10 to 48) in	(6 + 1*L*) µin (8 + 3.5*L*) µin (23 + 2.6*L*) µin (37 + 4.1*L*) µin	Universal Length Measuring Machine P & W Supermicrometer® Gage Amplifier, Probe Gage Blocks, Surface Plate
Inside	(0.04 to 1) in (1 to 2.5) in (2.5 to 7) in	(9 + 1*L*) µin (9 + 3*L*) µin (14 + 3*L*) µin	Universal Length Measuring Machine
Chamfer Gages [1]	Up to 2 in	52 µin	Cylindrical Ring Gages
Height Gages [1,4]	Up to 24 in	(30 + 3.2*L*) µin	Gage Blocks, Long Gage Blocks, Surface Plates

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Height Masters, Riser Blocks, Stands [1,4]	Up to 24 in	(35 + 2.7*L*) µin	Gage Amplifier, Probe, Surface Plate
Squareness [1]	Up to 24 in	27 µin	Gage Amplifier, Probe, Surface Plate
Straightness Size: Up to 72 in	Up to 0.05 in	76 µin	Gage Amplifier, Probe, Surface Plate
Optical Comparators [1,4] X, Y Length Angle Magnification	(0.01 to 6) in 15° 30° 45° 10X to 100X	76 µin 3.3″ 3.3″ 3.3″ 0.002 3 in	Calibration Grids Angle Blocks Calibration Grids
Thread Wires	Up 0.2 in	20 µin	Universal Length Measuring Machine
Cylindrical Ring Gages [4] Inside Diameter	Up to 4 in (4 to 12) in	(3.9 + 3.8*L*) µin (9.5 + 5.5*L*) µin	Universal Length Measuring Machine
Cylindrical Plug Gages 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	Universal Length Measuring Machine
Pin Gages Outside Diameter	(0.011 to 1) in	28 µin	P & W Supermicrometer®
Measuring Tapes, Rulers [4]	Up to 100 in (100 to 3 600) in	0.003 1 in (31*L*) µin	Fowler Horizontal Trimos
Surface Plates [1,4] Overall Flatness Local Area Flatness (Repeat Readings)	 (12 to 240) in*DL* Up to 0.001 in	 2√*DL* µin 38 µin	In accordance with ASME B89.3.7 using Laser Interferometer 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 + 4*L*) µin	P & W Supermicrometer®, Master Thread Wires
Major Diameter	(0.0625 to 10) in	18 µin	P & W Supermicrometer®
Step Height	Up to 1 in	51 µin	Height Gage
Tapered Plug Gages [4] Pitch Diameter	(0.0625 to 10) in	(120 + 4*L*) µin	P & W Supermicrometer®, Master Thread Wires
Standoff	Up to 1 in	51 µin	Gage Amplifier, Probe, Surface Plate
Radius Gages	Up to 1 in	260 µin	Optical Comparator
Feeler Gages, Thickness Gages	(0.001 5 to 0.25) in	24 µin	P & W Supermicrometer®
Coating Thickness Testers	Up to 0.06 in	1.1 % of reading + 2.2 µin	Master Films
Coating Thickness Standards	(0.001 to 0.01) in	4.7 µin	Universal Length Measuring Machine
	(0.01 to 0.36) in	28 µin	P & W Supermicrometer®
Sine Plates/Bars [4] (Up to 15 in) Flatness	Up to 0.05 in	9.6 µin	Gage Amplifier, 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 + 2.7*L*) µin	Gage Amplifier, Probe, Surface Plate
Parallels Steel (Up to 1.5 in x 6 in)	Up to 0.05 in	43 µin	Gage Amplifier, Probe, Surface Plate
Granite (Up to 8 in x 48 in)	Up to 0.05 in	43 µin	

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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	Gage Amplifier, Probe, Surface Plate, Master Setting Disk
Microscope Reticule	Up to 6 in	76 µin	Glass Scale
Bench Micrometer [4]	Up to 10 in	(9 + 4*L*) µin	Gage Blocks, Long Gage Blocks
Coordinate Measuring Machine [1,4] Linear Displacement Squareness Volumetric Repeatability	 Up to 200 in Up to 18 in Up to 72 in	 (7 + 1.3*L*) µin 43 µin 160 µin	 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 + 5*L*) µin	 CMM Sphere Conical Socket Ball Bar Kit

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Gas Flow 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
Pneumatic Gauge Pressure Devices [1]	Up to 2.5 inH_2O (> 2.5 to 28) inH_2O (-14.7 to 10) psig	0.003 5 inH_2O 0.009 inH_2O 0.02 psi	Comparison to Reference Pressure Transducers

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pneumatic Gauge Pressure Devices [1]	(10 to 1 000) psig	0.011 % of reading + 0.000 1 psi	Deadweight Tester
Hydraulic Gauge Pressure Devices [1]	Up to 10 000 psig	0.031 % of reading	Deadweight Tester
Pneumatic Absolute Pressure Devices [1]	Up to 30 psia	0.018 psi.	Comparison to Reference Absolute Pressure Transducer
Scales, 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, 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 Determination (SI)	(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	 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	Indirect verification per ASTM E18, ASTM E110 using Hardness Test Blocks.

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Rockwell Hardness and Superficial Testers [1]	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 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 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 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 HR45T	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.

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Vickers Hardness Testers [1]	HV Scale 300 HV 500 HV	 59 HV 17 HV	Indirect verification per ASTM E92 using Hardness Test Blocks.
Durometers [4] (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) in (0 to 0.105) mm (0 to 100) Duro	 180 µin 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
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 0.001 7 lbf 0.008 lbf 0.07 lbf	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 10 lbf·in to 2 000 lbf·ft	1.2 % of reading 0.32 % of reading	AWS-3000 Torque Analyzer AKO Torque Transducers with Display
Viscosity [1] (Dynamic)	(10 to 30 000) cP	0.8 % of reading	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	Rotronic HP23-A/HC2-S Temp/Humidity Indicator/Probe
Temperature – Measure [1]	(-50 to 200) °C (200 to 400) °C	0.019 °C 0.03 °C	SPRT, Temperature Indicator

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature – Source [1] (Thermometers, Probes, etc.)	(-50 to 200) °C (200 to 400) °C	0.019 °C 0.05 °C	Comparison to SPRT, Temperature Indicator, Heat Source
Infrared Thermometers [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	Blackbody Source (flat plate) ε = (0.9 to 1), λ = (8 to 14) µm

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source [1]	1 Hz to 10 GHz	12 nHz/Hz	HP 3325A Synthesizer/Function Generator, Giga-tronics 6061A GPS Frequency Standard
Frequency – Measure [1]	10 Hz to 1 GHz	1.7 nHz/Hz	Agilent 5386A Frequency Counter, GPS Frequency Standard
Stopwatches, Timers [1]	(1 to 86 400) s	36 ms/d	Agilent 5386A Frequency Counter, 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	Fluke 5560A Multiproduct Calibrator
Optical Rotational Speed [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	Fluke 5522A Multiproduct Calibrator, LED
Non-contact Rate of Rotation [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

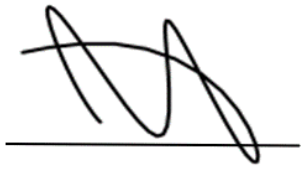
3 Dimensional

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; ″ = arc-second; rpm = revolutions per minute.
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 legal entity for this site is Transcat, Inc.
7. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2489.32.



Jason Stine, Vice President