



CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Transcat – Charlotte
8334 Arrowridge Blvd., Suite B
Charlotte, NC 28273

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.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 07 September 2023
Certificate Number: AC-2489.07



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,
ANSI/NCSL Z540-1-1994 (R2002) AND ANSI/NCSL Z540.3-2006 (R2013)**

Transcat – Charlotte
8334 Arrowridge Blvd., Suite B
Charlotte, NC 28273
Adam McCrea 704-529-6154

CALIBRATION

Valid to: **September 7, 2023**

Certificate Number: **AC-2489.07**

Acoustics and Vibration

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Sound Measuring Equipment 125 Hz to 2 kHz 4 kHz 125 Hz to 2 kHz 4 kHz	(74 to 104) dB (74 to 104) dB 114 dB 114 dB	0.46 dB 0.73 dB 0.37 dB 0.62 dB	GenRad 1986 Sound Level Calibrator
Sound Level Measure 125 Hz to 2 kHz 4 kHz 125 Hz to 2 kHz 4 kHz	(74 to 104) dB (74 to 104) dB 114 dB 114 dB	0.48 dB 0.74 dB 0.38 dB 0.63 dB	GenRad 1986 Sound Level Calibrator, Sound Meters

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Sine Wave Flatness ¹ 50 Ω, 3 V Input	Up to 3 V 10 Hz to 1 MHz (1 to 10) MHz (10 to 30) MHz (30 to 50) MHz (50 to 80) MHz (80 to 100) MHz	0.06 % of reading 0.1 % of reading 0.18 % of reading 0.41 % of reading 0.71 % of reading 0.84 % of reading	Ballantine 1395B Thermal Voltage Converter



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Measure/Source ¹	(0 to 100) μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	26 μ A/A + 0.8 nA 26 μ A/A + 5 nA 26 μ A/A + 50 nA 41 μ A/A + 0.5 μ A 0.13 mA/A + 10 μ A	Agilent 3458A 8.5 Digit Multimeter, Current Source
DC Current – Measure ¹	(1 to 100) A	0.06 % of reading	Leeds & Northrup 4363 Current Shunt, Digital Multimeter
DC Current – Source ¹	(0.22 to 2.2) A (2.2 to 11) A	92 μ A/A + 12 μ A 0.28 mA/A + 0.48 mA	Fluke 5700A-EP Multiproduct Calibrator, Fluke 5725A Amplifier
	(11 to 20) A	0.1 % of reading + 0.58 mA	Fluke 5520A Multiproduct Calibrator
DC Clamp-on Ammeters ¹ (Non-Toroidal Type)	(20 to 150) A (150 to 1 000) A	0.5 % of reading + 0.14 A 0.5 % of reading + 0.5 A	Fluke 5520A Multiproduct Calibrator, Fluke 5500A/Coil 50-turn Coil
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	0.46 % of reading + 30 nA 0.17 % of reading + 30 nA 0.07 % of reading + 30 nA 0.07 % of reading + 30 nA 0.46 % of reading + 0.2 μ A 0.17 % of reading + 0.2 μ A 0.07 % of reading + 0.2 μ A 0.04 % of reading + 0.2 μ A 0.46 % of reading + 2 μ A 0.17 % of reading + 2 μ A 0.07 % of reading + 2 μ A 0.04 % of reading + 2 μ A 0.46 % of reading + 20 μ A 0.17 % of reading + 20 μ A 0.07 % of reading + 20 μ A 0.04 % of reading + 20 μ A	Agilent 3458A 8.5 Digit Multimeter



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure ¹	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 + 0.2 mA 0.19 % of reading + 0.2 mA 0.1 % of reading + 0.2 mA 0.12 % of reading + 0.2 mA	Agilent 3458A 8.5 Digit Multimeter
AC Current – Measure ¹	1 A to 2 A 50 Hz to 1 kHz 2 A to 20 A 50 Hz to 1 kHz 20 A to 100 A 50 Hz to 1 kHz	0.12 % of reading + 0.2 mA 0.12 % of reading + 0.3 mA 0.12 % of reading + 0.3 mA	Ballantine 1625A AC/DC Current Shunt, Agilent 3458A 8.5 Digit Multimeter
AC Current – Source ¹	Up to 220 μ A (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (0.22 to 2.2) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (2.2 to 22) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (22 to 220) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (0.22 to 2.2) A 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.03 % of reading + 16 nA 0.02 % of reading + 10 nA 0.01 % of reading + 8 nA 0.03 % of reading + 12 nA 0.11 % of reading + 65 nA 0.03 % of reading + 40 nA 0.02 % of reading + 35 nA 0.01 % of reading + 35 nA 0.02 % of reading + 0.11 μ A 0.11 % of reading + 0.65 μ A 0.03 % of reading + 0.4 μ A 0.02 % of reading + 0.35 μ A 0.01 % of reading + 0.35 μ A 0.02 % of reading + 0.55 μ A 0.11 % of reading + 5 μ A 0.03 % of reading + 4 μ A 0.02 % of reading + 3.5 μ A 0.01 % of reading + 2.5 μ A 0.02 % of reading + 3.5 μ A 0.11 % of reading + 10 μ A 0.03 % of reading + 35 μ A 0.05 % of reading + 80 μ A 0.71 % of reading + 0.16 mA	Fluke 5700A-EP Multiproduct Calibrator



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ¹	(2.2 to 11) A 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.027 % of reading + 0.17 mA 0.098 % of reading + 0.38 mA 0.37 % of reading + 0.75 mA	Fluke 5700A-EP Multiproduct Calibrator, Fluke 5725A Amplifier
	(11 to 20.5) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.09 % of reading + 3.9 mA 0.12 % of reading + 3.9 mA 2.3 % of reading + 3.9 mA	Fluke 5520A Multiproduct Calibrator
	(20 to 100) A 50 Hz to 1 kHz	0.12 % of reading + 0.3 mA	Fluke 5520A Multiproduct Calibrator, Ballentine 1625A AC/DC Current Shunt, Agilent 3458A 8.5 Digit Multimeter
AC Current – Source ¹ Extended Frequency Ranges	29 µA to 329.99 µA (10 to 30) kHz 330 µA to 3.299 mA (10 to 30) kHz 3.3 mA to 32.99 mA (10 to 30) kHz 33 mA to 329.99 mA (10 to 30) kHz	1.2 % of reading + 0.31 µA 0.78 % of reading + 0.47 µA 0.31 % of reading + 3.1 µA 0.31 % of reading + 0.16 mA	Fluke 5520A Multiproduct Calibrator
AC Clamp-on Ammeters ¹ (Toroidal Type) Transformer Type Sensor	(20 to 150) A (45 to 65) Hz (65 to 440) Hz (150 to 1 000) A (45 to 65) Hz (65 to 440) Hz	0.3 % of reading + 26 mA 0.83 % of reading + 47 mA 0.35 % + 0.12 A 1.1 % of reading + 0.22 A	Fluke 5520A Multiproduct Calibrator, Fluke 5500A/Coil 50-turn Coil
AC Clamp-on Ammeters ¹ (Non-Toroidal Type) Hall Effect Sensor	(20 to 150) A (45 to 65) Hz (65 to 440) Hz (150 to 1 000) A (45 to 65) Hz (65 to 440) Hz	0.57 % of reading + 0.25 A 1 % of reading + 0.25 A 0.60 % of reading + 0.9 A 1.3 % of reading + 0.92 A	



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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	(0 to 10) Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1 GΩ	18 μΩ/Ω + 50 μΩ 15 μΩ/Ω + 0.5 mΩ 12 μΩ/Ω + 0.5 mΩ 12 μΩ/Ω + 5 mΩ 12 μΩ/Ω + 50 mΩ 19 μΩ/Ω + 2 Ω 62 μΩ/Ω + 0.1 kΩ 0.59 mΩ/Ω + 1 kΩ 0.58 % of reading + 10 kΩ	Agilent 3458A 8.5 Digit Multimeter, Decade Resistor
DC Resistance – Source ¹ (Fixed Artifacts)	100 μΩ 1 mΩ 10 mΩ 100 mΩ 1 Ω	81 nΩ 0.5 μΩ 2 μΩ 8.6 μΩ 0.1 mΩ	Standard Resistors
DC Resistance – Source ¹ (Variable Artifact)	(10 to 100) MΩ 100 MΩ to 1 GΩ (1 to 10) GΩ (10 to 100) GΩ 100 GΩ to 1 TΩ	0.08 % of reading 0.24 % of reading 0.42 % of reading 0.83 % of reading 2.4 % of reading	IET HRRS-B-7-100K-5KV Decade Resistor
DC Voltage – Measure ¹	(0 to 100) mV 100 mV to 10 V (10 to 100) V (100 to 500) V (500 to 800) V (800 to 1 000) V	7.1 μV/V + 0.5 μV 5.0 μV/V + 0.5 μV 7.6 μV/V + 30 μV 11 μV/V + 0.1 mV 14 μV/V + 0.1 mV 21 μV/V + 0.1 mV	Agilent 3458A 8.5 Digit Multimeter
DC High Voltage – Measure ¹	(1 to 2) kV (2 to 20) kV	0.05 % of reading + 0.4 V 0.05 % of reading + 4 V	Vitrek 4600A High Voltage Meter
	(20 to 50) kV (50 to 120) kV	0.08 % of reading 0.09 % of reading	High Voltage Divider with Digital Multimeter
DC Voltage – Source ¹	(2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1 100) V	4.1 μV/V + 2.5 μV 4 μV/V + 4 μV 6.3 μV/V + 40 μV 7.7 μV/V + 0.4 mV	Fluke 5700A-EP Multiproduct Calibrator



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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	Up to 10 mV		Agilent 3458A 8.5 Digit Multimeter
	(1 to 40) Hz	0.03 % of reading + 3 μV	
	40 Hz to 1 kHz	0.03 % of reading + 1.1 μV	
	(1 to 20) kHz	0.03 % of reading + 1.1 μV	
	(20 to 50) kHz	0.1 % of reading + 1.1 μV	
	(50 to 100) kHz	0.51 % of reading + 1.1 μV	
	(100 to 300) kHz	4 % of reading + 2 μV	
	(10 to 100) mV		
	(1 to 40) Hz	0.01 % of reading + 4 μV	
	40 Hz to 1 kHz	0.009 % of reading + 2 μV	
	(1 to 20) kHz	0.01 % of reading + 2 μV	
	(20 to 50) kHz	0.03 % of reading + 2 μV	
	(50 to 100) kHz	0.08 % of reading + 2 μV	
	(100 to 300) kHz	0.31 % of reading + 10 μV	
	300 kHz to 1 MHz	1 % of reading + 10 μV	
	100 mV to 1 V		
	(1 to 40) Hz	0.009 % of reading + 40 μV	
	40 Hz to 1 kHz	0.008 % of reading + 20 μV	
	(1 to 20) kHz	0.01 % of reading + 20 μV	
	(20 to 50) kHz	0.03 % of reading + 20 μV	
	(50 to 100) kHz	0.08 % of reading + 20 μV	
	(100 to 300) kHz	0.3 % of reading + 0.1 mV	
	300 kHz to 1 MHz	1 % of reading + 0.1 mV	
	(1 to 10) V		
(1 to 40) Hz	0.008 % of reading + 0.4 mV		
40 Hz to 1 kHz	0.009 % of reading + 0.2 mV		
(1 to 20) kHz	0.01 % of reading + 0.2 mV		
(20 to 50) kHz	0.03 % of reading + 0.2 mV		
(50 to 100) kHz	0.08 % of reading + 0.2 mV		
(100 to 300) kHz	0.3 % of reading + 1 mV		
300 kHz to 1 MHz	1 % of reading + 1 mV		
(10 to 100) V			
(1 to 40) Hz	0.02 % of reading + 4 mV		
40 Hz to 1 kHz	0.02 % of reading + 2 mV		
(1 to 20) kHz	0.02 % of reading + 2 mV		
(20 to 50) kHz	0.04 % of reading + 2 mV		
(50 to 100) kHz	0.12 % of reading + 2 mV		
(100 to 300) kHz	0.4 % of reading + 10 mV		
300 kHz to 1 MHz	1.5 % of reading + 10 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	(100 to 700) V (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.04 % of reading + 40 mV 0.04 % of reading + 20 mV 0.06 % of reading + 20 mV 0.12 % of reading + 20 mV 0.35 % of reading + 20 mV	Agilent 3458A 8.5 Digit Multimeter
AC High Voltage – Measure ¹	700 V to 2 kV (20 to 100) Hz (100 to 400) Hz (2 to 20) kV (20 to 100) Hz	0.09 % of reading + 2 V 0.53 % of reading + 2 V 0.34 % of reading + 20 V	Vitretek 4600A High Voltage Meter
	(20 to 85) kV 60 Hz	0.48 % of reading	High Voltage Divider with Digital Multimeter
AC Voltage – Source ¹	Up to 2.2 mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz (2.2 to 22) mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz (22 to 220) mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.04 % of reading + 4 μV 0.03 % of reading + 4 μV 0.03 % of reading + 4 μV 0.03 % of reading + 4 μV 0.06 % of reading + 5 μV 0.13 % of reading + 10 μV 0.2 % of reading + 20 μV 0.31 % of reading + 20 μV 0.04 % of reading + 4 μV 0.03 % of reading + 4 μV 0.01 % of reading + 4 μV 0.03 % of reading + 4 μV 0.06 % of reading + 5 μV 0.07 % of reading + 10 μV 0.17 % of reading + 20 μV 0.31 % of reading + 20 μV 0.02 % of reading + 12 μV 0.01 % of reading + 7 μV 0.008 % of reading + 7 μV 0.02 % of reading + 7 μV 0.04 % of reading + 17 μV 0.09 % of reading + 20 μV 0.15 % of reading + 25 μV 0.28 % of reading + 45 μV	Fluke 5700-EP Multiproduct Calibrator



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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	220 mV to 2.2 V		Fluke 5700-EP Multiproduct Calibrator
	(10 to 20) Hz	0.03 % of reading + 40 μV	
	(20 to 40) Hz	0.01 % of reading + 15 μV	
	40 Hz to 20 kHz	0.005 % of reading + 8 μV	
	(20 to 50) kHz	0.008 % of reading + 10 μV	
	(50 to 100) kHz	0.01 % of reading + 30 μV	
	(100 to 300) kHz	0.04 % of reading + 80 μV	
	(300 to 500) kHz	0.01 % of reading + 0.2 mV	
	500 kHz to 1 MHz	0.18 % of reading + 0.3 mV	
	(2.2 to 22) V		
	(10 to 20) Hz	0.03 % of reading + 0.4 mV	
	(20 to 40) Hz	0.01 % of reading + 0.15 mV	
	40 Hz to 20 kHz	0.005 % of reading + 50 μV	
	(20 to 50) kHz	0.008 % of reading + 0.1 mV	
	(50 to 100) kHz	0.01 % of reading + 0.2 mV	
(100 to 300) kHz	0.03 % of reading + 0.6 mV		
(300 to 500) kHz	0.11 % of reading + 2 mV		
500 kHz to 1 MHz	0.17 % of reading + 3.2 mV		
AC Voltage – Source ¹	(22 to 220) V		Fluke 5720A Multiproduct Calibrator, Fluke 5725A Amplifier
	(10 to 20) Hz	0.03 % of reading + 4 mV	
	(20 to 40) Hz	0.01 % of reading + 1.5 mV	
	40 Hz to 20 kHz	0.005 % of reading + 0.6 mV	
	(20 to 50) kHz	0.009 % of reading + 1 mV	
	(50 to 100) kHz	0.02 % of reading + 2.5 mV	
	(100 to 300) kHz	0.09 % of reading + 16 mV	
	(300 to 500) kHz	0.45 % of reading + 40 mV	
	500 kHz to 1 MHz	0.82 % of reading + 80 mV	
	AC Voltage – Source ¹ Extended Frequency Ranges	220 V to 1 100 V	
40 Hz to 1 kHz		0.011 % of reading + 4 mV	
(1 to 20) kHz		0.017 % of reading + 6 mV	
	(20 to 30) kHz	0.061 % of reading + 11 mV	
	220 V to 750 V		
	(30 to 50) kHz	0.062 % of reading + 11 mV	
	(50 to 100) kHz	0.24 % of reading + 45 mV	



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Measure ¹	Up to 10 pF	0.47 % of reading + 0.01 pF	GenRad 1689M Digibridge
	60 Hz to 1 kHz (10 to 100) pF	0.06 % of reading + 0.01 pF	
	60 Hz to 1 kHz 100 pF to 1 μF	0.02 % of reading + 0.01 pF	
	60 Hz to 1 kHz (1 to 100) μF	0.03 % of reading + 0.02 pF	
	60 Hz to 1 kHz 100 μF to 1 mF	0.24 % of reading + 0.02 pF	
Capacitance – Source ¹ (Fixed Artifacts)	(0.1 to 0.5) nF 100 Hz to 1 kHz	0.65 pF	Arco SS32 Standard Capacitor Kit
	0.5 nF to 1.4 μF 100 Hz to 1 kHz	0.13 pF	
Capacitance – Source ¹ (Simulation)	190 pF to 1.1 nF (1.1 to 3.3) nF (3.3 to 11) nF (11 to 110) nF (110 to 330) nF 330 nF to 1.1 μF (1.1 to 3.3) μF (3.3 to 11) μF (11 to 33) μF (33 to 110) μF (110 to 330) μF 330 μF to 1.1 mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF	0.39 % of reading + 7.8 pF 0.39 % of reading + 7.8 pF 0.21 % of reading + 7.8 pF 0.21 % of reading + 78 pF 0.21 % of reading + 0.23 nF 0.21 % of reading + 0.78 nF 0.21 % of reading + 2.3 nF 0.21 % of reading + 7.8 nF 0.32 % of reading + 23 nF 0.36 % of reading + 78 nF 0.36 % of reading + 0.23 μF 0.36 % of reading + 0.78 μF 0.36 % of reading + 2.3 μF 0.36 % of reading + 7.8 μF 0.61 % of reading + 23 μF 0.90 % of reading + 78 μF	Fluke 5520A Multiproduct Calibrator
Inductance – Measure ¹	60 Hz to 1 kHz (1 to 10) mH 10 mH to 1 H	0.03 % of reading + 0.1 μH 0.03 % of reading + 1.4 μH	GenRad 1689M Digibridge
	1 kHz		
Inductance – Source ¹ (Fixed Artifacts)	1 mH 10 mH 100 mH	0.12 % of reading 0.12 % of reading 0.12 % of reading	Standard Inductors



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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 – Measure/Source ¹	Type B		Ectron 1140A Thermocouple Calibrator/Simulator
	(250 to 350) °C	1 °C	
	(350 to 445) °C	0.77 °C	
	(445 to 580) °C	0.61 °C	
	(580 to 750) °C	0.47 °C	
	(750 to 1 000) °C	0.39 °C	
	(1 000 to 1 820) °C	0.31 °C	
	Type E		
	(-270 to -245) °C	2.1 °C	
	(-245 to -195) °C	0.2 °C	
	(-195 to -155) °C	0.11 °C	
	(-155 to -90) °C	0.09 °C	
	(-90 to 0) °C	0.08 °C	
	(0 to 15) °C	0.08 °C	
	(15 to 890) °C	0.07 °C	
	(890 to 1 000) °C	0.08 °C	
	Type J		
	(-210 to -180) °C	0.13 °C	
	(-180 to -120) °C	0.11 °C	
	(-120 to -50) °C	0.09 °C	
	(-50 to 990) °C	0.08 °C	
	(990 to 1 200) °C	0.08 °C	
	Type K		
	(-270 to -255) °C	2.3 °C	
	(-255 to -195) °C	0.73 °C	
	(-195 to -115) °C	0.14 °C	
	(-115 to -55) °C	0.1 °C	
	(-55 to 1 000) °C	0.08 °C	
(1 000 to 1 372) °C	0.09 °C		
Type N			
(-270 to -260) °C	5.1 °C		
(-260 to -200) °C	1.1 °C		
(-200 to -140) °C	0.25 °C		
(-140 to -70) °C	0.16 °C		
(-70 to 25) °C	0.13 °C		
(-25 to 160) °C	0.11 °C		
(160 to 1 300) °C	0.1 °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 – Measure/Source ¹	Type R		Ectron 1140A Thermocouple Calibrator/Simulator	
	(-50 to -30) °C	0.68 °C		
	(-30 to 45) °C	0.58 °C		
	(45 to 160) °C	0.42 °C		
	(160 to 380) °C	0.31 °C		
	(380 to 775) °C	0.28 °C		
	(775 to 1 768) °C	0.23 °C		
	Type S			
	(-50 to -30) °C	0.65 °C		
	(-30 to 45) °C	0.59 °C		
	(45 to 105) °C	0.42 °C		
	(105 to 310) °C	0.35 °C		
	(310 to 615) °C	0.31 °C		
	(615 to 1 768) °C	0.27 °C		
	Type T			
(-270 to -255) °C	1.8 °C			
(-255 to -240) °C	0.51 °C			
(-240 to -210) °C	0.32 °C			
(-210 to -150) °C	0.19 °C			
(-150 to -40) °C	0.13 °C			
(-40 to 100) °C	0.09 °C			
(100 to 400) °C	0.08 °C			
Scope Voltage – Source ¹ DC Signal			Fluke 9500B Oscilloscope Calibrator	
into 50 Ω	(-5.0 to 5.0) V	0.02% of reading + 19 μV		
into 1 MΩ	(-200 to 200) V	0.02% of reading + 19 μV		
Scope Voltage – Source ¹ Square Wave			Fluke 9500B Oscilloscope Calibrator	
	10 Hz to 100 kHz into 50 Ω	40 μVp-p to 1 mVp-p 1 mVp-p to 5 Vp-p		0.78 % of reading + 7.8 μV 0.08 % of reading + 7.8 μV
	10 Hz to 10 kHz into 1 MΩ	40 μVp-p to 1 mVp-p		0.78 % of reading + 7.8 μV
	10 Hz to 100 kHz into 1 MΩ	1 mVp-p to 200 Vp-p		0.08 % of reading + 7.8 μV



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scope – Time Markers ¹ 100 mVp-p to 1 Vp-p (into 50 Ω) Square Wave Sine Wave Pulse Triangle Wave	9.009 1 ns to 83 μs 83 μs to 55 s 450.5 ps to 9.009 ns 900.91 ns to 83 μs 83 μs to 55 s 900.91 ns to 83 μs 83 μs to 55 s	0.19 μs/s 2.3 μs/s 0.19 μs/s 0.19 μs/s 2.3 μs/s 0.19 μs/s 2.3 μs/s	Fluke 9500B Oscilloscope Calibrator
Rise Time – Measure ¹	800 ps to 1 μs	0.93 ns	Tektronix TDS 5054 Digital Oscilloscope
Scope Rise Time – Source ^{1,4} (into 50 Ω) 10 Hz to 2 MHz	5 mVp-p to 3 Vp-p 500 ps (Nominal) 150 ps (Nominal)	290 ps 34 ps	Fluke 9500B Oscilloscope Calibrator with Fluke 9530 Active Head
Scope Leveled Sine Wave – Source ¹ (50 kHz Ref. Frequency) into 50 Ω	50 kHz to 10 MHz	1.2 % of reading	Fluke 9500B Oscilloscope Calibrator with Fluke 9530 Active Head
Scope Bandwidth/Flatness – Source ¹ into VSWR (1.2:1) (wrt Reference Frequency)	5 mVp-p to 5 Vp-p 0.1 Hz to 300 MHz (300 to 550) MHz 5 mVp-p to 3 Vp-p 550 MHz to 2.5 GHz 5 mVp-p to 2 Vp-p (2.5 to 3.2) GHz	1.6 % of reading 1.9 % of reading 2.7 % of reading 3.1 % of reading	Fluke 9500B Oscilloscope Calibrator with Fluke 9530 Active Head
Scope Input Impedance – Measure ¹	(10 to 40) Ω (40 to 90) Ω (90 to 150) Ω (50 to 800) kΩ 800 kΩ to 1.2 MΩ (1.2 to 12) MΩ	0.39 % of reading 0.08 % of reading 0.39 % of reading 0.39 % of reading 0.08 % of reading 0.39 % of reading	Fluke 9500B Oscilloscope Calibrator
Scope Input Capacitance – Measure ¹	(1 to 35) pF (35 to 95) pF	1.6 % of reading + 0.19 pF 2.3 % of reading + 0.19 pF	Fluke 9500B/3200 Oscilloscope Calibrator



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Power – Source ¹ (0.33 to 330) mA (0.33 to 3) A (3 to 20.5) A	11 μW to 1.1 mW 1.1 mW to 110 mW 0.11W to 110 W 110 W to 330 W 11 W to 110 mW 0.11 W to 990 W 1 W to 3 kW 0.099 W to 0.99 W 0.99 W to 6.8 kW 6.8 W to 20.5 kW	0.02 % of reading 0.03 % of reading 0.02 % of reading 0.02 % of reading 0.04 % of reading 0.05 % of reading 0.01 % of reading 0.09 % of reading 0.07 % of reading 0.04 % of reading	Fluke 5520A Multiproduct Calibrator
AC Power – Source ^{1,2} (PF=1) (45 to 65) Hz (3.3 to 9) mA (9 to 33) mA (33 to 90) mA (90 to 330) mA (0.33 to 0.9) A (0.9 to 2.2) A (2.2 to 4.5) A (4.5 to 20.5) A	(0.11 to 3) mW 3.0 mW to 9.0 W (0.3 to 10) mW 10 mW to 33 W (1 to 30) mW 30 mW to 90 W (3 to 100) mW 100 mW to 300 W (11 to 300) mW 300 mW to 900 W 30 mW to 0.72 W 0.72 W to 2 kW 80 mW to 1.4 W 1.4 W to 4.5 kW 150 mW to 6.7 W 6.7 W to 20 kW	0.13 % of reading 0.08 % of reading 0.09 % of reading 0.08 % of reading 0.07 % of reading 0.06 % of reading 0.09 % of reading 0.08 % of reading 0.07 % of reading 0.08 % of reading 0.09 % of reading 0.08 % of reading 0.09 % of reading 0.18 % of reading 0.17 % of reading 0.17 % of reading	Fluke 5520A Multiproduct Calibrator
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	0.1 ° 0.2 ° 0.4 ° 1.9 ° 3.9 ° 7.8 °	Fluke 5520A Multiproduct Calibrator



ANSI National Accreditation Board

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power – Measure (50 Ω Load) 100 kHz to 4.2 GHz	(-30 to 20) dBm 1 μW to 100 mW	1.7 % of reading	Agilent 437 RF Power Meter, Agilent 8482A Power Sensor
Total Harmonic Distortion – Measure 5 Hz to 600 kHz Fundamental Input Voltage: < 30 V Level: (0.3 to 100) % 0.1 % Input Voltage: > 30 V Level: (0.3 to 100) % 0.1 %	10 Hz to 1 MHz (1 to 3) MHz (10 to 20) Hz (20 to 30) Hz 30 Hz to 300 kHz (300 to 500) kHz 500 kHz to 1.2 MHz 10 Hz to 300 kHz (300 to 500) kHz 500 kHz to 3 MHz (10 to 20) Hz (20 to 30) Hz 30 Hz to 300 kHz (300 to 500) kHz 500 kHz to 1.2 MHz	3.5 % Distortion 6.9 % Distortion 14 % Distortion 6.9 % Distortion 3.5 % Distortion 6.9 % Distortion 14 % Distortion 3.5 % Distortion 6.9 % Distortion 14 % Distortion 14 % Distortion 6.9 % Distortion 3.5 % Distortion 6.9 % Distortion 14 % Distortion	Agilent 334A Distortion Analyzer
Total Harmonic Distortion	(-110 to 0) dBm 100 Hz to 1.5 GHz	1.8 dB	Rigol DSA815 Spectrum Analyzer

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Gage Blocks ³	(0.05 to 1) in (1 to 4) in	(1.5 + 1.4L) μin (0.7 + 1.9L) μin	Federal Gage Block Comparator, Grade 1 Gage Blocks
	(1 to 10) mm (10 to 100) mm	(0.028 + 4X) μm (0.075 + 1.5X) μm	
Angles ³	Up to 75 °	5.3"	Angle Blocks, Master Square, Surface Plate
	90 °	1.2"	

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Calipers ^{1,3} (Outside, Inside, Depth & Step)	Up to 8 in (8 to 48) in	(20 + 5L) μin (13 + 7L) μin	Gage Blocks
Micrometers ^{1,3} (Outside, Inside, & Depth)	Up to 8 in (8 to 48) in	(20 + 5L) μin (13 + 7L) μin	Gage Blocks
Anvil Flatness ¹	Up to 3 in	6.7 μin	Optical Flats
Length Single Axis ³ Outside Dimension Inside Dimension	Up to 1 in (1 to 6) in (0.04 to 1) in (1 to 2.5) in (2.5 to 6) in	(6 + 1L) μin (4 + 3L) μin (9 + 1L) μin (10 + 3L) μin (15 + 3L) μin	Universal Length Measuring Machine
Height Gages ^{1,3}	Up to 8 in (8 to 44) in	(30 + 2L) μin (10 + 4L) μin	Gage Blocks
Height – Measure ^{1,3}	Up to 8 in (8 to 44) in	(37 + 2L) μin (11 + 4L) μin	Comparison to Gage Blocks using Test Indicator with Electronic Amplifier
Indicators ^{1,3}	Up to 6 in	(4 + 7L) μin	Comparison to Gage Blocks or to Supermicrometer
Parallelism & Straightness ⁴	Up to 3 in (3 to 24) in	(20 + 3L) μin (30 + 3L) μin	Gage Amplifier, Surface Plate
Ring Gages ³ (Inside Diameter)	(0.040 to 1) in (1 to 2.5) in (2.5 to 6) in	(9 + 1L) μin (10 + 3L) μin (15 + 3L) μin	Universal Length Measuring Machine
Pin Gages (Outside Diameter)	Up to 1 in	33 μin	Laser Micrometer
Plug Gages ³ (Outside Diameter)	Up to 1 in (1 to 6) in	12 μin (10 + 3L) μin	Universal Length Measuring Machine
Thread Wires	(2 to 120) TPI (0.008 to 0.5) in	12 μin	Universal Length Measuring Machine
Thread Plugs ³ (60° Thread) Pitch Diameter Major Diameter	Up to 1 in (1 to 4) in (4 to 6) in Up to 1 in (1 to 6) in	79 μin 80 μin 83 μin 13 μin (10 + 3L) μin	Thread Wires, Universal Length Measuring Machine
Measuring Tapes and Rulers ¹	Up to 96 in	14 μin/in + 0.006 in	Glass Scale

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Laser Micrometers ^{1,3}	Up to 1 in	(13 + 3L) μin	Master Gage Pins
Optical Comparators ¹ (Linearity)	(0.05 to 12) in X-Axis Y-Axis X-Y Axis	200 μin 200 μin 260 μin	Glass Scale, Cylindrical Square
Length – Measure (2-D)	X Axis Up to 9 in Y Axis Up to 4 in	290 μin 290 μin	Optical Comparator

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Force Gages – Tension and Compression ¹	(0 to 500) lbf	0.025 % of reading + 0.000 15 lbf	NIST Class F Weights
	(50 to 500) lbf	0.31 lbf	Interface Gold System
	(500 to 2 000) lbf	0.19 lbf	
	(2 000 to 5 000) lbf	2.3 lbf	
	(5 000 to 10 000) lbf	1.5 lbf	
(10 000 to 25 000) lbf	4 lbf		
Mass Determination (Metric)	30 kg 25 kg 20 kg 10 kg 5 kg 2 kg 1 kg 500 g 200 g 100 g 50 g 20 g 10 g 5 g 2 g 1 g	33 mg 33 mg 19 mg 9 mg 3.7 mg 3.3 mg 1.1 mg 0.37 mg 0.18 mg 0.23 mg 97 μg 70 μg 35 μg 21 μg 27 μg 29 μg	Echelon III

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Mass Determination (Metric)	500 mg	17 µg	Echelon III
	200 mg	17 µg	
	100 mg	16 µg	
	50 mg	16 µg	
	20 mg	16 µg	
	10 mg	16 µg	
	5 mg	16 µg	
	2 mg	16 µg	
	1 mg	16 µg	
Mass Determination (Avoirdupois)	50 lb	45 mg	Echelon III
	30 lb	45 mg	
	20 lb	45 mg	
	10 lb	8.2 mg	
	5 lb	8.2 mg	
	3 lb	7.3 mg	
	2 lb	6.8 mg	
	1 lb	6.8 mg	
	8 oz	6.8 mg	
	4 oz	2.31 mg	
	2 oz	2.31 mg	
	1 oz	2.31 mg	
	0.5 oz	2.31 mg	
Rockwell Hardness and Superficial Testers ¹	HRC		Indirect Verification per ASTM E18 using Test Blocks
	High	0.53 HRC	
	Middle	0.73 HRC	
	Low	0.92 HRC	
	HRBW		
	High	1.2 HRBW	
Middle	1.2 HRBW		
Low	1.3 HRBW		
Durometers ¹	Type A, B, O	0.31 duro units	Duro Calibrator per ASTM D2240
	Type D, C, DO	0.16 duro units	
Torque – Measure ¹	2.5 ozf·in to 1 000 lbf·ft (1 000 to 2 000) lbf·ft	0.50 % of reading 0.39 % of reading	CDI Torque Measuring System
Torque Measuring Equipment	2.5 ozf·in to 500 lbf·ft 500 lbf·in to 1 000 lbf·ft	0.06 % of reading 0.07 % of reading	Torque Wheels/Arms, NIST Class F Weights

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scales and Balances ^{1,5} Metric Load	30 kg 25 kg 20 kg 10 kg 5 kg 2 kg 1 kg 500 g 200 g 100 g 50 g 20 g 10 g 5 g 2 g 1 g 500 mg 200 mg 100 mg 50 mg 20 mg 10 mg 5 mg 2 mg 1 mg	36 mg 33 mg 27 mg 7.2 mg 4.5 mg 6.3 mg 1 mg 0.35 mg 0.27 mg 0.38 mg 0.21 mg 0.16 mg 83 µg 42 µg 35 µg 21 µg 14 µg 14 µg 11 µg 11 µg 11 µg 11 µg 11 µg 11 µg 11 µg 11 µg	ASTM E617 Class 1 Weights and internal calibration procedure utilized in the calibration of the weighing device.
Repeatability Eccentricity	1 mg to 90 kg 1 mg to 90 kg	0.8 <i>D</i> 0.8 <i>D</i>	
Scales and Balances ^{1,5} Avoirdupois Load	(1 to 500) lb	0.013 % of reading	NIST Class F Weights and internal calibration procedure utilized in the calibration of the weighing device.
Repeatability	(1 to 500) lb	0.8 <i>D</i>	
Eccentricity	(1 to 500) lb	0.8 <i>D</i>	
Pneumatic Absolute Pressure – Source	(0.1 to 30) psia (30 to 1 000) psia	0.002 4 psi 0.007 % of reading + 0.000 5 psi	DHI PPC4 Pressure Controller, RPM4 Indicator

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pneumatic Pressure – Source	(-14.2 to 30) psig (30 to 1 000) psig	0.002 psi 0.007 % of reading + 0.000 1 psi	DHI PPC4 Pressure Controller, RPM4 Indicator
	(0.14 to 0.36) inH ₂ O	0.06 % of reading + 44 μinH ₂ O	Ametek RK-1100 WC Deadweight Tester
	(-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	0.009 % of reading + 150 μinH ₂ O 0.002 inH ₂ O 0.01 % of reading + 150 μinH ₂ O 0.007 inH ₂ O 0.01 % of reading + 150 μinH ₂ O	DHI PPC4 Pressure Controller
Hydraulic Pressure – Source ¹	(10 to 16 000) psig	0.01 % of reading	Pressurements P3125-3 Hydraulic Deadweight Tester

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Relative Humidity – Measure ¹	(10 to 30) °C (20 to 80) % RH	1.3 % RH	Vaisala HMI41/HMP46 Temperature/Humidity Probe with Indicator
Relative Humidity – Source	(-10 to 15) °C (10 to 75) % RH (75 to 95) % RH (15 to 35) °C (10 to 95) % RH (35 to 70) °C (10 to 50) % RH (50 to 75) % RH (75 to 95) % RH	0.5 % RH 0.65 % RH 0.5 % RH 0.5 % RH 0.7 % RH 0.85 % RH	Humidity Generator
Temperature – Measure ¹	(-195 to 0) °C (0 to 420) °C (420 to 600) °C	0.001 % of reading + 0.012 °C 0.001 % of reading + 0.026 °C 0.001 % of reading + 0.036 °C	Hart 5628 Secondary PRT with Indicator
Temperature – Source	(-80 to 100) °C (100 to 200) °C	0.022 °C 0.023 °C	Liquid Bath, Hart 5628 Secondary PRT with Indicator
	(200 to 300) °C (300 to 600) °C	0.07 °C 0.085 °C	Dry Block Calibrator, Hart 5628 Secondary PRT with Indicator

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Infrared Temperature Measuring Equipment	(-15 to 0) °C (0 to 50) °C (50 to 100) °C (100 to 120) °C (120 to 200) °C (200 to 350) °C (350 to 500) °C	0.8 °C 0.65 °C 0.7 °C 0.76 °C 0.95 °C 1.6 °C 2.1 °C	Black Body Source (flat plate) $\epsilon = 0.95, \lambda = (8 \text{ to } 14) \mu\text{m}$


Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source/Measure	10 MHz	5.9 nHz/Hz	Rubidium Oscillator
Frequency – Source/Measure ¹	10 MHz	29 nHz/Hz	Universal Frequency Counter
Time Measuring Equipment (Electronic)	60 s to 720 hr	58 s/day	Vibrograf TM-4500 LCD-Clock-Tester

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 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 laboratory for more information regarding uncertainties at frequency and power factor combinations other than the ones shown.
3. L = Length in inches; " = arc-second; X = Length in millimeters.
4. The stated uncertainty is the laboratory's ability to source a fast rise pulse that is approximately 500 ps or 150 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.
5. D is based upon "Readability" of scale or balance.
6. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2489.07.



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