



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 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.

A handwritten signature in black ink, appearing to read 'R. Douglas Leonard Jr.', is positioned above a horizontal line.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 07 September 2021

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
AND ANSI/NCSL Z540-1-1994 (R2002)**

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

CALIBRATION

Valid to: **September 7, 2021**

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	(74 to 104) dB	0.46 dB	GenRad 1986 Sound Level Calibrator
4 kHz	(74 to 104) dB	0.73 dB	
125 Hz to 2 kHz	114 dB	0.37 dB	
4 kHz	114 dB	0.62 dB	
Sound Level Measure			
125 Hz to 2 kHz	(74 to 104) dB	0.48 dB	GenRad 1986 Sound Level Calibrator with Sound Meters
4 kHz	(74 to 104) dB	0.74 dB	
125 Hz to 2 kHz	114 dB	0.38 dB	
4 kHz	114 dB	0.63 dB	

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
DC Current – Measure/Source ¹	(0 to 100) μA 100 μA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	26 μA/A + 0.8 nA 26 μA/A + 5 nA 26 μA/A + 50 nA 41 μA/A + 500 nA 130 μA/A + 10 μA	Agilent 3458A Multimeter with Current Source
DC Current – Measure ¹	(1 to 100) A	0.06 % of reading	Leeds & Northrup 4363 Shunt with Digital Multimeter
DC Current – Source ¹	(0.22 to 2.2) A (2.2 to 11) A	92 μA/A + 12 μA 0.28 mA/A + 0.48 mA	Fluke 5700A-EP Calibrator w/ Fluke 5725A Amplifier
	(11 to 20) A	0.1 % of reading + 0.58 mA	Fluke 5520A Calibrator
DC Clamp-on Ammeters (Non-Toroidal Type) ¹	(20 to 150) A (150 to 1 000) A	0.50 % of reading + 0.14 A 0.51 % of reading + 0.5 A	Fluke 5520A Calibrator with Fluke 5500A/Coil

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 + 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 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 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 with Agilent 3458A Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment		
AC Current – Source ¹	Up to 220 μ A (10 to 20) Hz (20 to 40) Hz 40 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	Fluke 5700A-EP Calibrator		
	(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	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			
	(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	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			
	(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	0.03 % 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			
	(0.22 to 2.2) A 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.03 % of reading + 35 μ A 0.05 % of reading + 80 μ A 0.71 % of reading + 0.16 mA			
	(2.2 to 11) A 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.027 % of reading + 170 μ A 0.098 % of reading + 380 μ A 0.37 % of reading + 750 μ A		Fluke 5700A-EP Calibrator w/ Fluke 5725A Amplifier	
	AC Current – Source ¹	(11 to 20.5) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz		0.09 % of reading + 3.9 mA 0.12 % of reading + 3.9 mA 2.3 % of reading + 3.9 mA	Fluke 5520A Calibrator
		(20 to 100) A 50 Hz to 1 kHz		0.12 % of reading + 0.3 mA	Fluke 5520A Calibrator, Ballentine 1625A AC/DC Current Shunt, Agilent 3458A Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source Extended Frequency Ranges ¹	29 μ A to 329.99 μ A (10 to 30) kHz 330 μ A 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 μ A 0.78 % of reading + 0.47 μ A 0.31 % of reading + 3.1 μ A 0.31 % of reading + 0.16 mA	Fluke 5520A Calibrator
AC Clamp-on Ammeters (Toroidal Type) Transformer Type Sensor ¹	(20 to 150) A (45 to 65) Hz (65 to 440) Hz (150 to 1 000) A (45 to 65) Hz (65 to 440) Hz	0.30 % of reading + 26 mA 0.83 % of reading + 47 mA 0.35 % + 0.12 A 1.1 % of reading + 0.22 A	Fluke 5520A Calibrator w/ Fluke 5500A/Coil
AC Clamp-on Ammeters (Non-Toroidal Type) Hall Effect Sensor ¹	(20 to 150) A (45 to 65) Hz (65 to 440) Hz (150 to 1 000) A (45 to 65) Hz (65 to 440) Hz	0.57 % 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	
DC Resistance – Measure/Source ¹	(0 to 10) Ω (10 to 100) Ω 100 Ω to 1 k Ω (1 to 10) k Ω (10 to 100) k Ω 100 k Ω to 1 M Ω (1 to 10) M Ω (10 to 100) M Ω 100 M Ω to 1 G Ω	18 $\mu\Omega/\Omega$ + 50 $\mu\Omega$ 15 $\mu\Omega/\Omega$ + 0.5 m Ω 12 $\mu\Omega/\Omega$ + 0.5 m Ω 12 $\mu\Omega/\Omega$ + 5 m Ω 12 $\mu\Omega/\Omega$ + 50 m Ω 19 $\mu\Omega/\Omega$ + 2 Ω 62 $\mu\Omega/\Omega$ + 100 Ω 0.59 m Ω/Ω + 1 k Ω 0.58 % of reading + 10 k Ω	Agilent 3458A Multimeter with Decade Resistor
DC Resistance – Source ¹ Fixed	100 $\mu\Omega$ 1 m Ω 10 m Ω 100 m Ω 1 Ω	810 $\mu\Omega/\Omega$ 500 $\mu\Omega/\Omega$ 200 $\mu\Omega/\Omega$ 86 $\mu\Omega/\Omega$ 100 $\mu\Omega/\Omega$	Standard Resistors
DC Resistance – Source ¹ Variable	(10 to 100) M Ω 100 M Ω to 1 G Ω (1 to 10) G Ω (10 to 100) G Ω 100 G Ω to 1 T Ω	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



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 μ V/V + 0.5 μ V 5.0 μ V/V + 0.5 μ V 7.6 μ V/V + 30 μ V 11 μ V/V + 0.1 mV 14 μ V/V + 0.1 mV 21 μ V/V + 0.1 mV	Agilent 3458A 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 μ V/V + 2.5 μ V 4 μ V/V + 4 μ V 6.3 μ V/V + 40 μ V 7.7 μ V/V + 0.4 mV	Fluke 5700A-EP Calibrator
AC Voltage – Measure ¹	Up to 10 mV (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (10 to 100) mV (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.03 % of reading + 3 μ V 0.03 % of reading + 1.1 μ V 0.03 % of reading + 1.1 μ V 0.1 % of reading + 1.1 μ V 0.51 % of reading + 1.1 μ V 4 % of reading + 2 μ V 0.01 % of reading + 4 μ V 0.009 % of reading + 2 μ V 0.01 % of reading + 2 μ V 0.03 % of reading + 2 μ V 0.08 % of reading + 2 μ V 0.31 % of reading + 10 μ V 1 % of reading + 10 μ V	Agilent 3458A Multimeter



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	100 mV to 1 V		Agilent 3458A Multimeter
	(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		
(100 to 700) V			
(1 to 40) Hz	0.04 % of reading + 40 mV		
40 Hz to 1 kHz	0.04 % of reading + 20 mV		
(1 to 20) kHz	0.06 % of reading + 20 mV		
(20 to 50) kHz	0.12 % of reading + 20 mV		
(50 to 100) kHz	0.35 % of reading + 20 mV		
AC High Voltage – Measure ¹	700 V to 2 kV		Vitrek 4600A High Voltage Meter
	(20 to 100) Hz	0.09 % of reading + 2 V	
	(100 to 400) Hz	0.53 % of reading + 2 V	
	(2 to 20) kV		High Voltage Divider with Digital Multimeter
	(20 to 100) Hz	0.34 % of reading + 20 V	
	(20 to 85) kV		
	60 Hz	0.48 % of reading	



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<p>AC Voltage – Source¹</p>	<p>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 220 mV to 2.2 V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz (2.2 to 22) V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz</p>	<p>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 0.03 % of reading + 40 μV 0.01 % of reading + 15 μV 0.005 % of reading + 8 μV 0.008 % of reading + 10 μV 0.01 % of reading + 30 μV 0.04 % of reading + 80 μV 0.01 % of reading + 0.2 mV 0.18 % of reading + 0.3 mV 0.03 % of reading + 0.4 mV 0.01 % of reading + 0.15 mV 0.005 % of reading + 50 μV 0.008 % of reading + 0.1 mV 0.01 % of reading + 0.2 mV 0.03 % of reading + 0.6 mV 0.11 % of reading + 2 mV 0.17 % of reading + 3.2 mV</p>	<p>Fluke 5700-EP Calibrator</p>
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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	(22 to 220) V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.03 % of reading + 4 mV 0.01 % of reading + 1.5 mV 0.005 % of reading + 0.6 mV 0.009 % of reading + 1 mV 0.02 % of reading + 2.5 mV 0.09 % of reading + 16 mV 0.45 % of reading + 40 mV 0.82 % of reading + 80 mV	Fluke 5700-EP Calibrator
AC Voltage – Source ¹	220 V to 1100 V 40 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 30 kHz	0.011 % + 4 mV 0.017 % + 6 mV 0.061 % + 11 mV	Fluke 5720A Calibrator with Fluke 5725A Amplifier
AC Voltage – Source Extended Frequency Ranges ¹	220 V to 750 V 30 kHz to 50 kHz 50 kHz to 100 kHz	0.062 % + 11 mV 0.24 % + 45 mV	
Capacitance – Measure ¹	Up to 10 pF 60 Hz to 1 kHz (10 to 100) pF 60 Hz to 1 kHz 100 pF to 1 μF 60 Hz to 1 kHz (1 to 100) μF 60 Hz to 1 kHz 100 μF to 1 mF 60 Hz to 1 kHz	0.47 % of reading + 0.01 pF 0.06 % of reading + 0.01 pF 0.02 % of reading + 0.01 pF 0.03 % of reading + 0.02 pF 0.24 % of reading + 0.02 pF	GenRad 1689M Digibridge
Capacitance – Source ¹ Fixed	(0.1 to 0.5) nF 100 Hz to 1 kHz 0.5 nF to 1.4 μF 100 Hz to 1 kHz	0.65 pF 0.13 pF	Arco SS32 Standard Capacitor Kit

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 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
Inductance – Source ¹ Fixed 1 kHz	1 mH 10 mH 100 mH	0.12 % of reading 0.12 % of reading 0.12 % of reading	Standard Inductors
Electrical Simulation of Thermocouple Indicating Devices – Measure/Source ¹	Type B (250 to 350) °C (350 to 445) °C (445 to 580) °C (580 to 750) °C (750 to 1 000) °C (1 000 to 1 820) °C Type E (-270 to -245) °C (-245 to -195) °C (-195 to -155) °C (-155 to -90) °C (-90 to 0) °C (0 to 15) °C (15 to 890) °C (890 to 1 000) °C	1 °C 0.77 °C 0.61 °C 0.47 °C 0.39 °C 0.31 °C 2.1 °C 0.2 °C 0.11 °C 0.09 °C 0.08 °C 0.08 °C 0.07 °C 0.08 °C	Ectron 1140A Thermocouple Calibrator/Simulator



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Electrical Simulation of Thermocouple Indicating Devices – Measure/Source ¹	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		0.10 °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		0.10 °C
	Type R		
	(-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			
Into 50 Ω	(-5.0 to 5.0) V	0.02% of reading + 19 μV	Ectron 1140A Thermocouple Calibrator/Simulator
Into 1 MΩ	(-200 to 200) V	0.02% of reading + 19 μV	
			Fluke 9500B Oscilloscope Calibrator



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scope Voltage – Source ¹ Square Wave 10 Hz to 100 kHz Into 50 Ω	40 μV p-p to 1 mV p-p 1 mV p-p to 5 V p-p	0.78 % of reading + 7.8 μV 0.08 % of reading + 7.8 μV	Fluke 9500B Oscilloscope Calibrator
10 Hz to 10 kHz Into 1 MΩ 10 Hz to 100 kHz Into 1 MΩ	40 μV p-p to 1 mV p-p 1 mV p-p to 200 V p-p	0.78 % of reading + 7.8 μV 0.08 % of reading + 7.8 μV	
Scope – Time Markers ¹ 100 mV p-p to 1 V p-p (into 50 Ω) Square Wave	9.009 1 ns to 83 μs 83 μs to 55 s	0.19 μs/s 2.3 μs/s	Fluke 9500B Oscilloscope Calibrator
Sine Wave	450.5 ps to 9.009 ns	0.19 μs/s	
Pulse	900.91 ns to 83 μs 83 μs to 55 s	0.19 μs/s 2.3 μs/s	
Triangle Wave	900.91 ns to 83 μs 83 μs to 55 s	0.19 μs/s 2.3 μs/s	
Rise Time – Measure ¹	800 ps to 1 μs	0.93 ns	TDS 5054 Oscilloscope
Scope Rise Time – Source ^{1,4} (into 50 Ω) 10 Hz to 2 MHz	5 mV p-p to 3 V p-p 500 ps (Nominal) 150 ps (Nominal)	290 ps 34 ps	Fluke 9500B Oscilloscope Calibrator with Fluke 9530 Active Head
Scope Levelled 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 mV p-p to 5 V p-p 0.1 Hz to 300 MHz (300 to 550) MHz 5 mV p-p to 3 V p-p 550 MHz to 2.5 GHz 5 mV p-p to 2 V p-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

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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
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 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 Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 Calibrator

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 with 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 % 6.9 % 14 % 6.9 % 3.5 % 6.9 % 14 % 3.5 % 6.9 % 14 % 14 % 6.9 % 3.5 % 6.9 % 14 %	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	(0 to 75) °	5.3 ”	Angle Blocks, Master Square, Surface Plate
	90 °	1.2 ”	
Calipers ^{1,3} (Outside, Inside, Depth & Step)	(0 to 8) in (8 to 48) in	(20 + 5L) μin (13 + 7L) μin	Gage Blocks
Micrometers ^{1,3} (Outside, Inside, & Depth)	(0 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	(0 to 1) in (1 to 6) in (0.04 to 1) in (1 to 2.5) in (2.5 to 6) in	(6.1 + 1L) μin (4.5 + 3.5L) μin (9.0 + 1L) μin (10 + 3L) μin (15 + 3L) μin	Universal Length Measuring Machine
Height Gages ^{1,3}	(0 to 8) in (8 to 44) in	(30 + 2L) μin (10 + 4L) μin	Gage Blocks
Height – Measure ^{1,3}	(0 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}	(0 to 6) in	(4 + 7L) μin	Comparison to Gage Blocks or to Supermicrometer
Parallelism & Straightness ⁴	(0 to 3) in (3 to 24) in	(20 + 3.2L) μin (30 + 3.2L) μin	Gage Amplifier, Surface Plate
Ring Gages ³ (Inside Diameter)	(0.040 to 1.0) in (1.0 to 2.5) in (2.5 to 6) in	(9.0 + 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

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Thread Plugs ³ (60 ° Thread) Pitch Diameter	(0 to 1.0) in (1.0 to 4.0) in (4.0 to 6.0) in	79 μin 80 μin 83 μin	Thread Wires, Universal Length Measuring Machine
Major Diameter	(0 to 1) in (1 to 6) in	13 μin (10 + 3.0L) μin	
Measuring Tapes and Rulers ¹	(0 to 96) in	14 μin/in + 0.006 in	Glass Scale
Laser Micrometers ^{1,3}	(0 to 1) in	(13 + 3.2L) μin	Master Gage Pins
Optical Comparators ¹	(0.05 to 12) in X Axis Y Axis X-Y Axis	200 μin 200 μin 260 μin	Glass Scale, Cylindrical Square
2-D Length – Measure	X Axis (0 to 9) in Y Axis (0 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 (500 to 2 000) lbf (2 000 to 5 000) lbf (5 000 to 10 000) lbf (10 000 to 25 000) lbf	0.31 lbf 0.19 lbf 2.3 lbf 1.5 lbf 4 lbf	Interface Gold System

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Mass Determination Metric	30 kg	33 mg	Echelon III
	25 kg	33 mg	
	20 kg	19 mg	
	10 kg	9.0 mg	
	5 kg	3.7 mg	
	2 kg	3.3 mg	
	1 kg	1.1 mg	
	500 g	0.37 mg	
	200 g	0.18 mg	
	100 g	0.23 mg	
	50 g	97 µg	
	20 g	70 µg	
	10 g	35 µg	
	5 g	21 µg	
	2 g	27 µg	
	1 g	29 µg	
	500 mg	17 µg	
	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	

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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	ANSI/ASTM Class 1 Weights
Scales and Balances ^{1,5} Avoirdupois Load	(1 to 500) lb	0.013 % of reading	NIST Class F Weights
Repeatability	(1 to 500) lb	0.8 <i>D</i>	
Eccentricity	(1 to 500) lb	0.8 <i>D</i>	
Absolute Pressure – Source Pneumatic	(0.1 to 30) psia (30 to 1 000) psia	0.002 4 psi 0.007 % of reading + 0.000 5 psi	DHI PPC4 with RPM4 Indicator

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pressure – Source ¹ Pneumatic	(-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 with 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
Pressure – Source ¹ Hydraulic	(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	0.5 %RH 0.65 %RH	Humidity Generator
	(15 to 35) °C (10 to 95) %RH	0.5 %RH	
	(35 to 70) °C (10 to 50) %RH (50 to 75) %RH (75 to 95) %RH	0.5 %RH 0.7 %RH 0.85 %RH	
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	0.80 °C	Black Body Source (flat plate) $\epsilon = 0.95, \lambda = (8 \text{ to } 14) \mu\text{m}$
	(0 to 50) °C	0.65 °C	
	(50 to 100) °C	0.70 °C	
	(100 to 120) °C	0.76 °C	
	(120 to 200) °C	0.95 °C	
	(200 to 350) °C	1.6 °C	
	(350 to 500) °C	2.1 °C	


Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source/Measure	10 MHz	5.9×10^{-10} Hz/Hz	Rubidium Oscillator
Frequency – Source/Measure ¹	10 MHz	2.9×10^{-9} Hz/Hz	Universal Frequency Counter
Time Measuring Equipment (Electronic)	60 s to 720 hr	0.058 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; 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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