CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Transcat - Portland
14058 SW Milton Court
Portland, OR 97224

Fulfills the requirements of

ISO/IEC 17025:2017

and national standards

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

In the field of

CALIBRATION

This certificate is valid only when accompanied by a current scope of accreditation document.
The current scope of accreditation can be verified at www.anab.org.

Jason Stine, Vice President

Expiry Date: 07 September 2025
Certificate Number: AC-2489.01

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

AND

ANSI/NCSL Z540-1-1994 (R2002)
ANSI/NCSL Z540.3 (R2013)

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CALIBRATION

Valid to: **September 7, 2025** Certificate Number: **AC-2489.01**

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Sine Wave Flatness [1]	Up to 3 V (10 to 100) Hz 100 Hz to 300 kHz 300 kHz to 10 MHz (10 to 20) MHz (20 to 30) MHz (30 to 50) MHz (50 to 70) MHz (70 to 80) MHz (80 to 100) MHz	 0.07 % of reading 0.071 % of reading 0.13 % of reading 0.21 % of reading 0.22 % of reading 0.48 % of reading 0.75 % of reading 0.89 % of reading 1 % of reading	Comparison to Thermal Voltage Converters
DC Current – Source/Measure [1]	Up to 100 µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	33 µA/A + 0.92 nA 29 µA/A + 5.8 nA 29 µA/A + 58 nA 46 µA/A + 0.58 µA 0.013 % of reading + 12 µA	Comparison to Agilent 3458A Opt 02 8.5 Digit Multimeter, Current Source
DC Current – Source/Measure [1]	(1 to 10) A (10 to 100) A (100 to 300) A	0.013 % of reading 0.048 % of reading 0.062 % of reading	Comparison to Guildline 9211 DC Current Shunt, Current Source
DC Clamp-on Ammeter (Non-Toroidal Type) Hall Effect Sensor [1]	(20 to 150) A (150 to 1 000) A	0.5 % of reading + 0.14 A 0.52 % of reading + 0.5 A	Comparison to Fluke 5520A Multiproduct Calibrator, Wavetek Coil

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Clamp-on Ammeter (Non-Toroidal Type) Hall Effect Sensor [1]	(1 000 to 5 000) A	0.58 % of reading	Comparison to Fluke 52120A Transconductance Amplifier, Fluke 5520A Multiproduct Calibrator, 3 kA or 6 kA Coil
AC Current – Measure [1]	Up to 100 µA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 1 kHz (0.1 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 (0.1 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 0.07 % 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	Comparison to Agilent 3458A Opt 02 8.5 Digit Multimeter
AC Current – Measure [1]	(1 to 3) A 10 Hz to 5 kHz (3 to 10) A 10 Hz to 1 kHz	 0.17 % of reading + 1.8 mA 0.18 % of reading + 6 mA	Comparison to Fluke 8846A 6.5 Digit Multimeter
AC Current – Measure [1]	(10 to 100) A 10 Hz to 1 kHz	 0.12 % of reading	Comparison to Ohms Labs Current Shunt, Digital 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 µA (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	 0.031 % of reading + 16 nA 0.019 % of reading + 10 nA 0.015 % of reading + 8 nA 0.03 % of reading + 12 nA 0.11 % of reading + 65 nA 0.03 % of reading + 40 nA 0.018 % of reading + 35 nA 0.013 % of reading + 35 nA 0.021 % of reading + 0.11 µA 0.11 % of reading + 0.65 µA 0.039 % of reading + 0.4 µA 0.019 % of reading + 0.35 µA 0.014 % of reading + 0.35 µA 0.021 % of reading + 0.55 µA 0.11 % of reading + 5 µA 0.033 % of reading + 4 µA 0.018 % of reading + 3.5 µA 0.014 % of reading + 2.5 µA 0.021 % of reading + 3.5 µA 0.11 % of reading + 10 µA 0.027 % of reading + 35 µA 0.046 % of reading + 80 µA 0.7 % of reading + 0.16 mA	Comparison to Fluke 5720A Multiproduct Calibrator
AC Current – Source [1]	(2.2 to 11) A 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	 0.048 % of reading + 0.17 mA 0.096 % of reading + 0.38 mA 0.36 % of reading + 0.75 mA	Comparison to Fluke 5720A Multiproduct Calibrator, Fluke 5725A Amplifier
AC Current – Source [1]	(11 to 20.5) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	 0.09 % of reading + 3.9 mA 0.12 % of reading + 3.9 mA 2.3 % of reading + 3.9 mA	Comparison to Fluke 5520 A Multiproduct Calibrator
AC Current – Source [1]	(20 to 100) A 10 Hz to 1 kHz	 0.12 % of reading	Comparison to Ohms Labs Current Shunt, Current Source

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source [1]	Up to 10 A 50 Hz to 1 kHz 1 kHz (10 to 100) A (50 to 100) Hz (100 to 999) Hz	 0.05 % of reading + 1.3 mA 0.12 % of reading + 1.3 mA 0.04 % of reading + 2.3 mA 0.42 % of reading + 2.3 mA	Comparison to Ohms Labs CS-100 Precision Shunt w/ Agilent 3458A Opt 02 Multimeter and Source
AC Current – Source [1] Extended Frequency Ranges	(29 to 330) µA (10 to 30) kHz (0.33 to 3.3) mA (10 to 30) kHz (3.3 to 33) mA (10 to 30) kHz (33 to 330) mA (10 to 30) kHz	 1.2 % of reading + 3 µA 0.78 % of reading + 0.5 µA 0.31 % of reading + 3 µA 0.31 % of reading + 0.16 mA	Comparison to Fluke 5520A Multiproduct Calibrator
AC Clamp-on Ammeters (Toroidal Type) Transformer Type Sensor [1]	(20 to 150) A (45 to 65) Hz (65 to 440) Hz (150 to 1 000) A (45 to 65) Hz (65 to 440) Hz	 0.34 % of reading + 35 mA 0.95 % of reading + 66 mA 0.38 % of reading + 0.17 A 1.2 % of reading + 0.29 A	Comparison to Fluke 5520A Calibrator, Wavetek 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	 0.66 % of reading + 0.26 A 1.2 % of reading + 0.29 A 0.68 % of reading + 1 A 1.4 % of reading + 1.2 A	Comparison to Fluke 5520A Calibrator, Wavetek Coil
AC Clamp-on Ammeters (Non-Toroidal Type) Hall Effect Sensor [1]	(1 000 to 6 000) A (10 to 300) Hz (300 to 440) Hz	 0.77 % of reading 0.77 % of reading	Comparison to Fluke 52120A Transconductance Amplifier, Fluke 5520A Multiproduct Calibrator, 3 kA or 6 kA Coil
DC Resistance – Source/Measure [1]	Up to 10 Ω (10 to 100) Ω (0.1 to 1) kΩ (1 to 10) kΩ (10 to 100) kΩ	18 µΩ/Ω + 58 µΩ 15 µΩ/Ω + 0.58 mΩ 13 µΩ/Ω + 0.58 mΩ 12 µΩ/Ω + 5.8 mΩ 13 µΩ/Ω + 58 mΩ	Comparison to Agilent 3458A Opt 02 8.5 Digit Multimeter, Decade Resistor

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Resistance – Source/Measure [1]	(0.1 to 1) MΩ (1 to 10) MΩ (10 to 100) MΩ (0.1 to 1) GΩ	21 μΩ/Ω + 2.3 Ω 62 μΩ/Ω + 120 Ω 0.059 % of reading + 1.2 kΩ 0.82 % of reading + 12 kΩ	Comparison to Agilent 3458A Opt 02 8.5 Digit Multimeter, Decade Resistor
DC Resistance – Source [1] (Fixed)	0.33 mΩ 1 mΩ 10 mΩ 100 mΩ	0.047 % of reading 0.037 % of reading 0.013 % of reading 0.012 % of reading	Comparison to DC Current Shunts
DC Resistance – Source (Variable)	(10 to 100) MΩ (0.1 to 1) GΩ (1 to 10) GΩ (10 to 100) GΩ (100 to 900) GΩ 1 TΩ	0.036 % of reading 0.13 % of reading 0.25 % of reading 0.59 % of reading 0.77 % of reading 1.6 % of reading	Comparison to Decade Resistor
DC Voltage – Source/Measure [1]	(0 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	8.3 μV/V + 0.58 μV 5.3 μV/V + 0.58 μV 5.3 μV/V + 0.58 μV 7.7 μV/V + 35 μV 15 μV/V + 0.12 mV 18 μV/V + 0.12 mV 21 μV/V + 0.12 mV	Comparison to Agilent 3458A Opt 02 8.5 Digit Multimeter, Fluke 5700A-EP Multiproduct Calibrator
DC High Voltage – Measure [1]	(1 to 10) kV (10 to 20) kV (20 to 70) kV (70 to 100) kV	0.04 % of reading + 92 mV 0.09 % of reading + 2.4 V 0.09 % of reading + 2.4 V 0.17 % of reading + 2.5 V	Comparison to Vitrek 4700 Digital HV Meter, Associated High Voltage Probes
DC Voltage – Source [1]	Up to 0.22 V (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1 100) V	8.6 μV/V + 0.4 μV 5.1 μV/V + 0.7 μV 4 μV/V + 2.5 μV 3.9 μV/V + 4 μV 6.2 μV/V + 40 μV 7.6 μV/V + 0.4 mV	Comparison to Fluke 5720A Multiproduct Calibrator, Fluke 5725A Amplifier
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 300 kHz to 1 MHz (1 to 4) MHz	 0.04 % of reading + 3.5 μV 0.03 % of reading + 1.2 μV 0.04 % of reading + 1.2 μV 0.15 % of reading + 1.2 μV 0.59 % of reading + 1.2 μV 4.6 % of reading + 2.3 μV 1.5 % of reading + 5.8 μV 8.1 % of reading + 8.1 μV	Comparison to Agilent 3458A Opt 02 8.5 Digit Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure [1]	(10 to 100) mV		Comparison to Agilent 3458A Opt 02 8.5 Digit Multimeter
	(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	
	(1 to 10) V		
	(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	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure [1]	(10 to 100) V		Comparison to Agilent 3458A Opt 2 8.5 Digit Multimeter
	(1 to 40) Hz	0.024 % of reading + 4.6 mV	
	40Hz 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		Comparison to Vitrek 4700 Digital HV Meter
	(20 to 100) Hz	0.14 % of reading + 0.37 V	
	(100 to 400) Hz	0.48 % of reading + 0.17 V	
AC High Voltage – Measure [1]	(10 to 30) kV		Comparison to Vitrek 4700 Digital HV Meter; Vitrek HVL-35, HVL-70, HVL-100 High Voltage Probes
	(30 to 70) Hz	0.11 % of reading + 2.4 V	
	(70 to 200) Hz	0.7 % of reading + 2.4 V	
	(200 to 450) Hz	1.4 % of reading + 2.4 V	
	(30 to 50) kV		
	(30 to 70) Hz	0.13 % of reading + 2.5 V	
	(70 to 200) Hz	0.7 % of reading + 2.5 V	
	(200 to 450) Hz	2.9 % of reading + 2.5 V	
	(50 to 70) kV		
	(30 to 70) Hz	0.16 % of reading + 2.6 V	
	(70 to 200) Hz	1.2 % of reading + 2.6 V	
AC Voltage – Source [1]	Up to 2.2 mV		Comparison to Fluke 5720A Multiproduct Calibrator
	(10 to 20) Hz	0.16 % of reading + 4 µV	
	(20 to 40) Hz	0.1 % of reading + 4 µV	
	40 Hz to 20 kHz	0.078 % of reading + 4 µV	
	(20 o 50) kHz	0.13 % of reading + 4 µV	
	(50 to 100) kHz	0.17 % of reading + 5 µV	
	(100 to 300) kHz	0.33 % of reading + 10 µV	
	(300 to 500) kHz	0.47 % of reading + 20 µV	
	500 kHz to 1 MHz	0.58 % of reading + 20 µV	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source [1]	(2.2 to 22) mV		Comparison to Fluke 5720A Multiproduct Calibrator
	(10 to 20) Hz	0.042 % of reading + 4 µV	
	(20 to 40) Hz	0.03 % of reading + 4 µV	
	40 Hz to 20 kHz	0.014 % of reading + 4 µV	
	(20 o 50) kHz	0.03 % of reading + 4 µV	
	(50 to 100) kHz	0.058 % of reading + 5 µV	
	(100 to 300) kHz	0.12 % of reading + 10 µV	
	(300 to 500) kHz	0.16 % of reading + 20 µV	
	500 kHz to 1 MHz	0.2 7% of reading + 20 µV	
	(22 to 220) mV		
	(10 to 20) Hz	0.028 % of reading + 12 µV	
	(20 to 40) Hz	0.011 % of reading + 7 µV	
	40 Hz to 20 kHz	0.008 5 % of reading + 7 µV	
	(20 o 50) kHz	0.021 % of reading + 7 µV	
	(50 to 100) kHz	0.047 % of reading + 17 µV	
	(100 to 300) kHz	0.091 % of reading + 20 µV	
	(300 to 500) kHz	0.14 % of reading + 25 µV	
	500 kHz to 1 MHz	0.28 % of reading + 45 µV	
	(0.22 to 2.2) V		
	(10 to 20) Hz	0.027 % of reading + 40 µV	
	(20 to 40) Hz	0.01 % of reading + 15 µV	
	40 Hz to 20 kHz	0.004 8 % of reading + 8 µV	
	(20 o 50) kHz	0.008 % of reading + 10 µV	
	(50 to 100) kHz	0.012 % of reading + 30 µV	
	(100 to 300) kHz	0.043 % of reading + 80 µV	
	(300 to 500) kHz	0.1 % 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	0.028 % of reading + 0.4 mV	
	(20 to 40) Hz	0.01 % of reading + 0.15 mV	
	40 Hz to 20 kHz	0.004 9 % of reading + 50 µV	
	(20 o 50) kHz	0.008 3 % 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	0.1 % of reading + 2 mV	
	500 kHz to 1 MHz	0.17 % of reading + 3.2 mV	

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 o 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	 0.028 % of reading + 4 mV 0.01 % of reading + 1.5 mV 0.005 6 % of reading + 0.6 mV 0.009 3 % of reading + 1 mV 0.016 % of reading + 2.5 mV 0.09 % of reading + 16 mV 0.44 % of reading + 40 mV 0.8 % of reading + 80 mV	Comparison to Fluke 5720A Multiproduct Calibrator
AC Voltage – Source [1]	(220 to 750) V (30 to 50) kHz (50 to 100) kHz (220 to 1 100) V 40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	 0.061 % of reading + 11 mV 0.23 % of reading + 45 mV 0.011 % of reading + 4 mV 0.017 % of reading + 6 mV 0.061 % of reading + 11 mV	Comparison to Fluke 5720A Multiproduct Calibrator, Fluke 5725A Amplifier
Capacitance – Source [1] (Simulation)	(0.19 to 3.3) nF (3.3 to 11) nF (11 to 110) nF (110 to 330) nF (0.33 to 1.1) µF (1.1 to 3.3) µF (3.3 to 11) µF (11 to 33) µF (33 to 110) µF (110 to 330) µF (0.33 to 1.1) mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF	0.39 % 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 0.2 % of reading + 0.78 nF 0.2 % of reading + 2.3 nF 0.2 % of reading + 7.8 nF 0.31 % of reading + 23 nF 0.35 % of reading + 78 nF 0.35 % of reading + 0.23 µF 0.35 % of reading + 0.78 µF 0.35 % of reading + 2.3 µF 0.35 % of reading + 7.8 µF 0.58 % of reading + 23 µF 0.86 % of reading + 78 µF	Comparison to Fluke 5520A Multiproduct Calibrator

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		Comparison to Ectron 1140A Thermocouple Calibrator/Simulator
	(250 to 350) °C	1.2 °C	
	(350 to 445) °C	0.9 °C	
	(445 to 580) °C	0.71 °C	
	(580 to 750) °C	0.55 °C	
	(750 to 1 000) °C	0.45 °C	
	(1 000 to 1 820) °C	0.35 °C	
	Type C		
	(0 to 250) °C	0.24 °C	
	(250 to 1 000) °C	0.19 °C	
	(1 000 to 1 500) °C	0.21 °C	
	(1 500 to 1 800) °C	0.24 °C	
	(1 800 to 2 000) °C	0.27 °C	
	(2 000 to 2 250) °C	0.33 °C	
	(2 250 to 2 315) °C	0.37 °C	
	Type E		
	(-270 to -245) °C	1.6 °C	
	(-245 to -195) °C	0.24 °C	
	(-195 to -155) °C	0.12 °C	
	(-155 to -90) °C	0.095 °C	
	(-90 to 0) °C	0.08 °C	
	(0 to 15) °C	0.076 °C	
	(15 to 890) °C	0.064 °C	
	(890 to 1 000) °C	0.074 °C	
	Type J		
	(-210 to -180) °C	0.15 °C	
	(-180 to -120) °C	0.12 °C	
	(-120 to -50) °C	0.093 °C	
	(-50 to 990) °C	0.08 °C	
	(990 to 1 200) °C	0.094 °C	
	Type K		
	(-270 to -255) °C	2.5 °C	
	(-255 to -195) °C	0.85 °C	
	(-195 to -115) °C	0.16 °C	
	(-115 to -55) °C	0.12 °C	
	(-55 to 1 000) °C	0.087 °C	
	(1 000 to 1 372) °C	0.096 °C	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices – Measure/Source [1]	Type N		Comparison to Ectron 1140A Thermocouple Calibrator/Simulator
	(-270 to -260) °C	5.4 °C	
	(-260 to -200) °C	1.5 °C	
	(-200 to -140) °C	0.29 °C	
	(-140 to -70) °C	0.18 °C	
	(-70 to 25) °C	0.14 °C	
	(-25 to 160) °C	0.12 °C	
	(160 to 1 300) °C	0.11 °C	
	Type R		
	(-50 to -30) °C	0.8 °C	
	(-30 to 45) °C	0.69 °C	
	(45 to 160) °C	0.49 °C	
	(160 to 380) °C	0.35 °C	
	(380 to 775) °C	0.3 °C	
	(775 to 1 768) °C	0.26 °C	
	Type S		
	(-50 to -30) °C	0.76 °C	
	(-30 to 45) °C	0.68 °C	
	(45 to 105) °C	0.49 °C	
	(105 to 310) °C	0.41 °C	
	(310 to 615) °C	0.35 °C	
	(615 to 1 768) °C	0.31 °C	
	Type T		
	(-270 to -255) °C	1.9 °C	
	(-255 to -240) °C	0.6 °C	
	(-240 to -210) °C	0.36 °C	
	(-210 to -150) °C	0.22 °C	
	(-150 to -40) °C	0.15 °C	
	(-40 to 100) °C	0.095 °C	
	(100 to 400) °C	0.08 °C	
Scope Voltage – Source [1]			Comparison to Fluke 5520A/1100 Multiproduct Calibrator
Amplitude DC			
into 50 Ω load	(-6 to 6) V	0.2 % of reading + 31 µV	
into 1 MΩ load	(-130 to 130) V	0.04 % of reading + 31 µV	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scope Voltage – Source [1] Square Wave into 50 Ω load into 1 MΩ load	10 Hz to 100 kHz 1 mV p-p to 6.6 Vp-p 10 Hz to 1 kHz 1 mV p-p to 6.6 Vp-p (1 kHz to 10) kHz 1 mV p-p to 6.6 Vp-p	0.19 % of reading + 31 µV 0.08 % of reading + 31 µV 0.19 % of reading + 31 µV	Comparison to Fluke 5520A/1100 Multiproduct Calibrator
Scope – Time Markers [1] into 50 Ω load	1 ns to 20 ms 50 ms 0.1 s 0.2 s 0.5 s 1 s 2 s 5 s	0.000 2 % of reading 2.3 µs 7.6 µs 28 µs 0.16 ms 0.62 ms 2.4 ms 15 ms	Comparison to Fluke 5520A/1100 Multiproduct Calibrator
Scope Rise Time – Source [1,2] into 50 Ω load Rate: 1 kHz to 2 MHz Rate: 2 MHz to 10 MHz	5 mVp-p to 2.5 Vp-p 250 ps (nominal) 250 ps (nominal)	 50 ps 50 ps	Comparison to Fluke 5520A/1100 Multiproduct Calibrator
Scope Leveled Sine Wave – Source [1] into 50 Ω load	5 mVp-p to 5 Vp-p 50 kHz 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHZ (600 to 1 100) MHz	 1.8 % of reading + 0.23 mV 2.8 % of reading + 0.23 mV 3.2 % of reading + 0.23 mV 4 % of reading + 0.23 mV 4.9 % of reading + 0.23 mV	Comparison to Fluke 5520A/1100 Multiproduct Calibrator
Scope Bandwidth/Flatness – Source [1] into 50 Ω load (50 kHz Reference)	5 mVp-p to 5.5 Vp-p 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1 100) MHz	 1.4 % of reading + 78 µV 1.8 % of reading + 78 µV 3.2 % of reading + 78 µV 3.9 % of reading + 78 µV	Comparison to Fluke 5520A/1100 Multiproduct Calibrator
Scope Input Impedance – Measure [1]	(40 to 60) Ω (0.5 to 1.5) MΩ	0.082 % of reading 0.081 % of reading	Comparison to Fluke 5520A/1100 Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scope Input Capacitance – Measure [1]	(5 to 50) pF	3.9 % of reading + 0.39 pF	Comparison to Fluke 5520A/1100 Multiproduct Calibrator
Scope Waveform Generator – Source [1]			
Amplitude			
(Sine, Square, Triangle)	10 Hz to 10 kHz		Comparison to Fluke 5520A/1100 Multiproduct Calibrator
into 50 Ω load	1.8 mVp-p to 2.5 Vp-p	2.3 % of reading + 78 µV	
into 1 MΩ load	1.8 mVp-p to 55 Vp-p	2.3 % of reading + 78 µV	
Frequency (Sine, Square, Triangle)	10 Hz to 10 kHz	0.001 9 % of reading + 12 mHz	
LF Phase – Source [1]	(0 to 90)°		Comparison to Fluke 5520A/1100 Calibrator
	(10 to 65) Hz	0.11°	
	(65 to 500) Hz	0.2°	
	500 Hz to 1 kHz	0.39°	
	(1 to 5) kHz	1.9°	
	(5 to 10) kHz	3.9°	
	(10 to 30) kHz	7.8°	
DC Power – Source [1]			
(0.33 to 330) mA	11 µW to 1.1 mW	0.024 % of reading	Comparison to Fluke 5520A/1100 Calibrator
	1.1 mW to 0.11 W	0.027 % of reading	
	(0.11 to 110) W	0.024 % of reading	
	(110 to 330) W	0.018 % of reading	
(0.33 to 3) A	11 µW to 110 mW	0.044 % of reading	
	(0.11 to 990) W	0.053 % of reading	
	(0.99 to 3) kW	0.009 6 % of reading	
(3 to 20.5) A	99 mW to 0.99 W	0.088 % of reading	
	0.99 W to 6.8 kW	0.07 % of reading	
	(6.8 to 20.5) kW	0.04 % of reading	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Power – Source [1,6]			Comparison to Fluke 5520A/11 Multiproduct Calibrator
PF = 1			
(3.3 to 9) mA	(10 to 65) Hz		
	(0.11 mW to 3) mW	0.13 % of reading	
	3 mW to 9 W	0.077 % of reading	
(9 to 33) mA	(10 to 65) W		
	(0.3 to 10) mW	0.089 % of reading	
	10 mW to 33 W	0.077 % of reading	
(33 to 90) mA	(10 to 65) Hz		
	(1 to 30) mW	0.071 % of reading	
	30 mW to 90 W	0.057 % of reading	
(90 to 330) mA	(10 to 65) Hz		
	(3 to 100) mW	0.089 % of reading	
	100 mW to 300 W	0.078 % of reading	
(0.33 to 0.9) A	(10 to 65) Hz		
	(11 to 300) mW	0.071 % of reading	
	(0.3 to 900) W	0.081 % of reading	
(0.9 to 2.2) A	(10 to 65) Hz		
	(30 to 720) mW	0.089 % of reading	
	0.72 W to 2 kW	0.079 % of reading	
(2.2 to 4.5) A	(10 to 65) Hz		
	80 mW to 1.4 W	0.088 % of reading	
	1.4 W to 4.5 kW	0.18 % of reading	
(4.5 to 20.5) A	(10 to 65) Hz		
	150 mW to 230 kW	0.17 % of reading	

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Total Harmonic Distortion – Measure	(-80 to 0) dB		Comparison to Agilent 8903B Audio Analyzer
	20 Hz to 20 kHz	1.2 dB	
	(20 to 100) kHz	2.3 dB	
Harmonic Distortion	9 kHz to 100 MHz	1.7 dB	Comparison to Agilent 8592L Spectrum Analyzer
Rise Time – Measure [1]	≥700 ps	0.81 ns	Comparison to Tektronix TDS3052 Digital Oscilloscope

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Angle Measuring Devices [3]	(0.017 to 5)° (5 to 20)° (20 to 35)° (35 to 45)° (45 to 60)° (60 to 75)° (75 to 85)° 90°	1.7″ 2.4″ 3.8″ 5.1″ 8.5″ 18″ 55″ 1.7″	Comparisons to Sine Bar, Gage Blocks, Surface Plate Granite Master Square
Bubble Levels [3]	(0 to 140)″	3″	Comparison to Gage Blocks
Micrometers and Calipers– Outside, Inside, Depth [1,3]	(0.05 to 1) in (1 to 9) in (5 to 15) in (15 to 40) in	13 µin (10 + 4*L*) µin (11 + 4.6*L*) µin (14 + 4.6*L*) µin	Comparison to Gage Blocks, Long Blocks
Anvil Flatness [1]	Up to 1 in Diameter	4.7 µin	Comparison to Optical Flats
Anvil Parallelism [1]	Up to 1 in	6.1 µin	Comparison to Optical Parallels
Dial Indicators [1,3]	Up to 0.1 in (0.1 to 6) in	4.5 µin (4 + 4*L*) in	Comparison to Gage Blocks, Surface Plate
Height Gages, Digital Indicators [3]	(0.05 to 1) in (1 to 9) in (4 to 15) in (15 to 24) in	(10 + 3*L*) µin (12 + 4*L*) µin (11 + 4.6*L*) µin (14 + 4.6*L*) µin	Comparison to Gage Blocks, Long Blocks, Surface Plate
Length – Single Axis[3] Outside Dimension Inside Dimension	 Up to 1 in (1 to 7) in (7 to 12) in (0.04 to 1) in (1 to 2.5) in (2.5 to 10) in (10 to 14) in	 (6 + 1*L*) µin (4 + 4*L*) µin (4.5*L*) µin (10 + 1*L*) µin (9 + 4*L*) µin (12 + 4*L*) µin (26 + 3*L*) µin	 Comparison to Universal Length Measuring Machine
Linear Dimensions – Two Axis (X-Y)	12 in x 12 in	320 µin	Comparison to Vision System
Master 1-2-3 Blocks, Caliper Masters, Parallels [3]	Up to 6 in (6 to 24) in	(10 + 3*L*) µin (12 + 4*L*) µin	Comparison to Gage Blocks, Surface Plate, Gage Amplifier

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Optical Comparators [1,3]			Comparison to Linear Glass Scale
X-Y Length	Up to 2 in (2 to 12) in	(42 + 36*L*) µin (75 + 27*L*) µin	
Squareness	(0.001 to 10) in	(90 + 1*L*) µin	Glass Scale
Magnification	(10 to 50) X	(120 + 10*L*) µin	Magnification Checker
Parallelism, Straightness	Up to 12 in	20 µin	Comparison to Gage Amplifier, Surface Plate
Cylindrical Plug Gages [3]			Comparison to Universal Length Measuring Machine
Outside Diameter	Up to 1 in (1 to 7) in	12 µin (10 + 3.5*L*) µin	
Cylindrical Ring Gages [3]			Comparison to Universal Length Measuring Machine
Inside Diameter	(0.4 to 1) in (1 to 2.5) in (2.5 to 10) in (10 to 14) in	(10 + 1*L*) µin (9 + 4*L*) µin (12 + 4*L*) µin (26 + 3*L*) µin	
Steel Rules	Up to 12 in	320 µin	Comparison to
Surface Plates [1,3]			In accordance with Fed Spec GGG-P-463 utilizing Electronic Levels
Overall Flatness	Up to 168.4 in*DL*	1.7 √*DL* + 5.5 µin	
Local Area Flatness (Repeat Readings)	Up to 0.001 in	32 µin	Supramess Indicator
Thread Plug Gages [3]			Comparison to Thread Wires, Universal Length Measuring Machine
Pitch Diameter	Up to 1 in (1 to 4) in (4 to 7) in	79 µin 80 µin 84 µin	
Major Diameter	Up to 1 in (1 to 7) in	13 µin (10 + 3.5*L*) µin	
Threaded Ring			Comparison to Master Setting Plugs
Pitch Diameter	Up to 1 in (1 to 4) in (4 to 7) in	79 µin 80 µin 84 µin	
Thread Wires	(2 to 120) TPI (0.008 33 to 0.5) in	12 µin	Comparison to Universal Length Measuring Machine

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Durometers Spring Force Type A, B, E, O Type D, C, DO Indenter Length	 Up to 100 Duro Up to 100 Duro Up to 1 in	 0.79 Duro 0.8 Duro 320 µin	Partial Verification per ASTM D2240 using Durometer Calibrator Vision System
Force Measuring Equipment	(10 to 100) gf	0.04 % of reading	Comparison to ASTM E617 Class 2 Weights
Force Measuring Equipment	(0.2 to 500) lbf	0.025 % of reading + 0.001 lbf	Comparison to NIST Class F Weights
Force Measuring Equipment	(500 to 1 000) lbf	0.58 lbf	Comparison to Master Load Cells
Mass – Measure	1 g to 1 kg (1 to 5.1) kg	18 mg 0.18 g	Comparison to Mettler PR5003 DR Electronic Balance
Balances and Scales [1,4] (Metric)	Up to 500 mg (0.5 to 10) g 10 g to 3 kg (3 to 8) kg (8 to 13) kg (13 to 19) kg (19 to 27) kg (27 to 38) kg (38 to 40) kg	6 µg 22 µg 6 mg 8 mg 13 mg 16 mg 76 mg 77 mg 78 mg	SET 1: ASTM E617 Class 1 weights and internal calibration procedure utilized for the calibration of the weighing system.
Balances and Scales [1,4] (Metric)	Up to 500 mg (0.5 to 5) g (5 to 10) g (10 to 20) g 50 g to 3 kg (3 to 5) kg (5 to 10) kg (10 to 14) kg (14 to 19) kg (19 to 23) kg (23 to 26) kg (26 to 29) kg (29 to 33) kg (33 to 35) kg (35 to 40) kg	20 µg 40 µg 60 µg 90 µg 10 mg 15 mg 20 mg 34 mg 37 mg 76 mg 77 mg 78 mg 82 mg 83 mg 84 mg	SET 2: ASTM E617 Class 1 weights and internal calibration procedure utilized for the calibration of the weighing system.

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Balances and Scales [1,4] Avoirdupois Metric	Up to 1 lb (1 to 1 600) lb Up to 500 g 500 g to 726 kg	0.024 % of reading 0.012 % of reading 0.024 % of reading 0.012 % of reading	NIST Class F weights and internal calibration procedure utilized for the calibration of the weighing system.
Torque Devices [1]	(3 to 15) ozf·in (15 to 200) ozf·in (1 to 12.5) lbf·ft (12.5 to 600) lbf·ft (600 to 2 000) lbf·ft	1.7 % of reading + 0.006 ozf·in 0.44 % of reading + 0.3 ozf·in 0.44 % of reading 0.34 % of reading 1.3 % of reading	Comparison to Torque Calibrator
Torque Calibration Equipment	(2.5 to 15) ozf·in (15 to 80) ozf·in	0.055 % of reading 0.06 % of reading	Comparison to Torque Wheels, Weights
Torque Calibration Equipment	(0.42 to 50) lbf·ft (50 to 2 000) lbf·ft	0.06 % of reading 0.06 % of reading	Comparison to Torque Arm, Weights
Absolute Pressure – Source	(0 to 30) psia (30 to 1 000) psia	0.002 4 psi 0.006 6 % of reading + 0.000 1 psi	Fluke/DHI RPM 4 Comparison to Pressure Controller/Calibrator
Pressure – Source [1]	(0.14 to 25) psig	0.017 % of reading + 0.000 041 psi	Comparison to Ametek RK-1000 WC Deadweight Tester
Pressure – Source	(-15 to 30) psig (30 to 1 000) psig	0.002 1 psi 0.006 6 % of reading + 0.000 1 psi	Comparison to Fluke/DHI RPM 4 Pressure Controller/Calibrator
Pressure – Source [1] (Hydraulic)	(5 to 15 000) psig	0.018 % of reading	Comparison to Fluke RPM4-E-DWT Deadweight Tester

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 (50 to 70) %RH (70 to 95) %RH	 0.5 %RH 0.65 %RH 0.5 %RH 0.7 %RH 0.85 %RH	Comparison to Thunder Scientific 2500 Two-Pressure Humidity Generator
Relative Humidity – Measure [1]	(10 to 30) °C (10 to 90) %RH (90 to 99) %RH	 1.3 %RH 2.3 %RH	Comparison to Vaisala HMI41/HMP46 Temperature/Humidity Indicator w/ Probe
Temperature – Measure [1]	(-196 to 0) °C (0 to 420) °C (420 to 660) °C	0.011 °C 0.026 °C 0.035 °C	Comparison to AccuMac AM1760 Secondary SPRT, Black Stack Indicator
Temperature – Measure [1]	(660 to 1 000) °C (1 000 to 1 200) °C	0.93 °C 1.2 °C	Comparison to AccuMac AM1210 Type S Thermocouple Reference Standard, Black Stack Indicator
Temperature – Source	(-20 to 120) °C	0.028 °C	Comparison to RTD Probe, Temperature Indicator; Liquid Bath
Temperature – Source	(120 to 600) °C	0.13 °C	Comparison to RTD Probe, Temperature Indicator; Dry-block Calibrator
Infrared Measuring Devices	(-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	0.98 °C 0.67 °C 0.71 °C 0.77 °C 0.94 °C 1.7 °C 2.1 °C	Comparison to Hart Black Body (flat plate) ε = (0.1 to 1), λ = (8 to 14) µm

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Reference [5]	10 MHz	6.4 nHz/Hz	Comparison to SRS FS725 Rubidium Frequency Standard
Frequency – Source/Measure [1]	30 Hz to 225 MHz	2.1 µHz/Hz	Comparison to HP 53131A (10) Frequency Counter, SRS FS725 Rubidium Frequency Standard
Time – Measure [1]	Up to 599 s/month	58 ms/d	Comparison to Vibrograf 4500 Timometer
AC Duty Cycle – Source [1] Square Wave: < 3.3 Vp-p Freq: 0.1 Hz to 100 kHz	(1 to 10) % Duty Cycle 10 µs to 100 s (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 (90 to 99) % Duty Cycle 10 µs to 100 s	0.62 % of reading + 78 ns 0.039 % of reading + 78 ns 0.001 6 % of reading + 78 ns 0.039 % of reading + 78 ns 0.62 % of reading + 78 ns	Comparison to Fluke 5522A Multiproduct Calibrator

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 stated uncertainty is the laboratory's ability to source a fast rise pulse that is approximately 250 ps. In the typical application of measuring rise time of an oscilloscope, this value is one of the contributing factors, but other factors are derived from the DUT. The known source rise time is mathematically removed from the total measured rise time measured on the DUT.
3. L = length in inches; DL = diagonal length in inches; ″ = arc-second.
4. 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.
5. As frequency & amplitude deviate from the listed values, uncertainty may be higher than stated. If needed, contact laboratory for more information regarding uncertainties at frequency and range combinations other than the ones shown.
6. 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.
7. Unless otherwise specified in the far-right column, the laboratory is utilizing an in-house developed calibration procedure.
8. The legal entity for this location is Transcat, Inc.
9. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2489.01.

Jason Stine, Vice President