



CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Transcat – Los Angeles
1503 E. Orangethorpe Ave., Unit A
Fullerton, CA 92831

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 fields of

CALIBRATION and DIMENSIONAL MEASUREMENT

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-2489.08



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

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

AND

ANSI/NCSL Z540-1-1994 (R2002)

ANSI/NCSL Z540.3-2006 (R2013)

Transcat – Los Angeles

1503 E. Orangethorpe Ave., Unit A

Fullerton, CA 92831

Mathew Bundy 657-217-3684

CALIBRATION AND DIMENSIONAL MEASUREMENT

Valid to: **September 7, 2025**

Certificate Number: **AC-2489.08**

CALIBRATION

Acoustics and Vibration

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Sound Level Measuring Equipment – Measure and Generate	125 Hz to 2 kHz		GenRad 1986 Sound Level Calibrator
	(74 to 104) dB	0.46 dB	
	114 dB	0.36 dB	
	4 kHz		
	(74 to 104) dB	0.73 dB	
	114 dB	0.62 dB	

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH – Measuring Equipment ^{1,7}	4 pH	0.011 pH	Accredited Buffer Solutions
	7 pH	0.011 pH	
	10 pH	0.012 pH	
Conductivity Meters ⁷	10 µS/cm	0.5 µS/cm	Accredited Buffer Solutions
	100 µS/cm	2.2 µS/cm	
	1 000 µS/cm	3.7 µS/cm	
	10 000 µS/cm	36 µS/cm	
	100 000 µS/cm	440 µS/cm	



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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 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	Thermal Voltage Converters
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	33 μ A/A + 0.92 nA 29 μ A/A + 5.8 nA 29 μ A/A + 58 nA 46 μ A/A + 0.58 μ A 0.013 % of reading + 12 μ A	Agilent 3458A 8.5 Digit Multimeter w/ Current Source
DC Current – Measure/Source ¹	(1 to 100) A	0.012 % of reading + 0.5 mA	Ohms Labs CS-100 Precision Shunt w/ Agilent 3458A 8.5 Digit Multimeter
DC Current – Measure/Source ¹	(100 to 580) A	0.29 mA/A + 0.58 mA	DC Current Shunts w/ DMM and Current Source
DC Current – Measure ¹	(580 to 1 000) A	0.29 mA/A + 0.5 mA	DC Current Shunt w/ DMM
DC Current – Source ¹	(0 to 220) μ A 220 μ A to 2.2 mA (2.2 to 22) mA (22 to 220) mA 0.22 A to 2.2 A (2.2 to 11) A	40 μ A/A + 6 nA 36 μ A/A + 7 nA 35 μ A/A + 40 nA 48 μ A/A + 0.7 μ A 84 μ A/A + 12 μ A 0.036 % of reading + 0.48 mA	Fluke 5700A-EP Multiproduct Calibrator, w/ Fluke 5725A Amplifier
DC Current – Source ¹	(11 to 20) A	0.096 % of reading + 0.58 mA	Fluke 5522A Multiproduct Calibrator
DC Clamp-on Ammeters (Non-Toroidal Type) Transformer Type Sensor ¹	(20 to 150) A (150 to 1 000) A	0.58 % of reading + 0.14 A 0.58 % of reading + 0.52 A	Fluke 5520A/1100 Multiproduct Calibrator w/ Fluke 5500A/Coil



ANSI National Accreditation Board

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		Agilent 3458A 8.5 Digit Multimeter
	(10 to 20) Hz	0.46 % of reading + 35 nA	
	(20 to 45) Hz	0.17 % of reading + 35 nA	
	(45 to 100) Hz	0.072 % of reading + 35 nA	
	100 Hz to 5 kHz	0.072 % of reading + 35 nA	
	100 μ A to 1 mA		
	(10 to 20) Hz	0.46 % of reading + 0.23 μ A	
	(20 to 45) Hz	0.17 % of reading + 0.23 μ A	
	(45 to 100) Hz	0.071 % of reading + 0.23 μ A	
	100 Hz to 5 kHz	0.038 % of reading + 0.23 μ A	
	(1 to 10) mA		
	(10 to 20) Hz	0.46 % of reading + 2.3 μ A	
	(20 to 45) Hz	0.17 % of reading + 2.3 μ A	
	(45 to 100) Hz	0.071 % of reading + 2.3 μ A	
100 Hz to 5 kHz	0.038 % of reading + 2.3 μ A		
(10 to 100) mA			
(10 to 20) Hz	0.48 % of reading + 23 μ A		
(20 to 45) Hz	0.17 % of reading + 23 μ A		
(45 to 100) Hz	0.071 % of reading + 23 μ A		
100 Hz to 5 kHz	0.037 % of reading + 23 μ A		
100 mA to 1 A			
(10 to 20) Hz	0.46 % of reading + 0.23 mA		
(20 to 45) Hz	0.19 % of reading + 0.23 mA		
(45 to 100) Hz	0.097 % of reading + 0.23 mA		
100 Hz to 5 kHz	0.12 % of reading + 0.23 mA		
AC Current – Measure ¹	Up to 10 A		Ohms Labs CS-100 Precision Shunt w/ Agilent 3458A 8.5 Digit Multimeter
	50 Hz to 1 kHz	0.015 % of reading + 1.3 mA	
	1 kHz	0.12 % of reading + 1.3 mA	
	10 A to 100 A		
	(50 to 100) Hz	0.038 % of reading + 2.3 mA	
	100 Hz to 1 kHz	0.14 % of reading + 2.3 mA	
1 kHz	0.12 % of reading + 2.3 mA		

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 (0.22 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 μ A 0.11 % of reading + 0.65 μ A 0.039 % of reading + 0.4 μ A 0.019 % of reading + 0.35 μ A 0.014 % of reading + 0.35 μ A 0.021 % of reading + 0.55 μ A 0.11 % of reading + 5 μ A 0.033 % of reading + 4 μ A 0.018 % of reading + 3.5 μ A 0.014 % of reading + 2.5 μ A 0.021 % of reading + 3.5 μ A 0.11 % of reading + 10 μ A 0.027 % of reading + 35 μ A 0.046 % of reading + 80 μ A 0.7 % of reading + 0.16 mA	Fluke 5700A-EP 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	Fluke 5700A-EP Multiproduct 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	0.092 % of reading + 3.9 mA 0.12 % of reading + 3.9 mA 2.3 % of reading + 3.9 mA	Fluke 5522A Multiproduct Calibrator
AC Current – Source ¹	(10 to 100) A (50 to 60) Hz 400 Hz 1 kHz	0.22 mA/A + 5 mA 0.26 mA/A + 5 mA 1.1 mA/A + 1.3 mA	Ohms Labs CS-100 Precision Shunt w/ Agilent 3458A 8.5 Digit Multimeter and Current Source

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 5522A 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	Fluke 5522A Multiproduct 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	0.66 % of reading + 0.26 A 1.2 % of reading + 0.29 A 0.68 % of reading + 1 A 1.4 % of reading + 1.1 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 $\mu\Omega/\Omega$ + 58 $\mu\Omega$ 15 $\mu\Omega/\Omega$ + 0.58 m Ω 13 $\mu\Omega/\Omega$ + 0.58 m Ω 12 $\mu\Omega/\Omega$ + 5.8 m Ω 13 $\mu\Omega/\Omega$ + 58 m Ω 21 $\mu\Omega/\Omega$ + 2.3 Ω 62 $\mu\Omega/\Omega$ + 120 Ω 0.059 % of reading + 1.2 k Ω 0.82 % of reading + 12 k Ω	Agilent 3458A 8.5 Digit Multimeter w/ Decade Resistor
DC Resistance – Source ^{1,7} (Fixed Artifact)	1 m Ω	50 $\mu\Omega/\Omega$	L&N 4223B Standard Resistor
DC Resistance – Source ^{1,7} (Fixed Artifact)	10 m Ω	52 $\mu\Omega/\Omega$	L&N 4222B Standard Resistor
DC Resistance – Source ^{1,7} (Fixed Artifact)	100 m Ω	0.15 m Ω/Ω	L&N 4015B Standard Resistor
DC Resistance – Source ^{1,7} (Fixed Artifacts)	1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω	98 $\mu\Omega$ 96 $\mu\Omega$ 0.24 m Ω 0.48 m Ω 1.1 m Ω 2.1 m Ω	Fluke 5700A-EP Multiproduct Calibrator



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Resistance – Source ^{1,7} (Fixed Artifacts)	1 kΩ	9.4 mΩ	Fluke 5700A-EP Multiproduct Calibrator
	1.9 kΩ	18 mΩ	
	10 kΩ	94 mΩ	
	19 kΩ	0.18 Ω	
	100 kΩ	1.2 Ω	
	190 kΩ	2.3 Ω	
	1 MΩ	22 Ω	
	1.9 MΩ	44 Ω	
	10 MΩ	0.42 kΩ	
	19 MΩ	0.36 kΩ	
	100 MΩ	11 kΩ	
DC Resistance – Source ^{1,7} (Variable Artifact)	(100 to 1 000) kΩ	0.037 % of reading	IET HRRS-B-3-1G-5KV Decade Resistor
	(1 to 10) MΩ	0.037 % of reading + 1.2 μΩ/Ω/V	
	(10 to 100) MΩ	0.12 % of reading + 1.2 μΩ/Ω/V	
	(100 to 1 000) MΩ	0.24 % of reading + 1.2 μΩ/Ω/V	
	(1 to 10) GΩ	0.58 % of reading + 1.2 μΩ/Ω/V	
	(10 to 100) GΩ	1.2 % of reading + 2.3 μΩ/Ω/V	
DC Resistance – RTD Measure ¹	(0 to 25) Ω	42 μΩ	Hart 1590 Super Thermometer Readout
	(25 to 400) Ω	1.3 μΩ/Ω	
	400 to 1 kΩ	4.1 μΩ/Ω	
	(1 to 40) kΩ	10 μΩ/Ω	
DC Voltage – Source ¹	(0 to 220) mV	8.8 μV/V + 0.4 μV	Fluke 5700A-EP Multiproduct Calibrator
	(0.22 to 2.2) V	5.1 μV/V + 0.7 μV	
	(2.2 to 11) V	4 μV/V + 2.5 μV	
	(11 to 22) V	3.9 μV/V + 4 μV	
	(22 to 220) V	6.2 μV/V + 40 μV	
DC Voltage – Measure ¹	(220 to 1 100) V	7.6 μV/V + 0.4 mV	Agilent 3458A Opt. 002 8.5 Digit Multimeter
	Up to 100 mV	8.3 μV/V + 0.58 μV	
	(0.1 to 10) V	5.3 μV/V + 0.58 μV	
	(10 to 100) V	7.7 μV/V + 35 μV	
	(100 to 500) V	15 μV/V + 0.12 mV	
	(500 to 800) V	18 μV/V + 0.12 mV	
DC High Voltage – Measure ¹	(800 to 1 000) V	21 μV/V + 0.12 mV	VitreK 4700 DVM w/ Associated High Voltage Probes
	(1 to 10) kV	0.04 % of reading + 40 mV	
	(10 to 35) kV	0.064 % of reading + 66 mV	
	(35 to 70) kV	0.088 % of reading + 80 mV	
	(70 to 100) kV	0.17 % of reading + 0.92 V	



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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 1 mV		Rohde & Schwarz URE3 RMS Voltmeter
	100 kHz to 1 MHz	1.8 % of reading + 2.4 μV	
	(1 to 3) MHz	3.5 % of reading + 2.4 μV	
	(3 to 10) MHz	9.3 % of reading + 2.4 μV	
	(10 to 20) MHz	23 % of reading + 2.4 μV	
	(1 to 3) mV		
	100 kHz to 1 MHz	0.97 % of reading + 2 μV	
	(1 to 3) MHz	3.5 % of reading + 2 μV	
	(3 to 10) MHz	9.3 % of reading + 2 μV	
	(10 to 20) MHz	23 % of reading + 2 μV	
	(3 to 100) mV		
	100 kHz to 1 MHz	0.91 % of reading + 3 μV	
(1 to 3) MHz	1.8 % of reading + 3 μV		
(3 to 10) MHz	2.9 % of reading + 3 μV		
(10 to 20) MHz	7 % of reading + 3 μV		
(20 to 30) MHz	14 % of reading + 3 μV		
AC Voltage – Measure ¹	Up to 10 mV		Agilent 3458A 8.5 Digit Multimeter
	(1 to 40) Hz	0.04 % of reading + 3.5 μV	
	40 Hz to 1 kHz	0.03 % of reading + 1.2 μV	
	(1 to 20) kHz	0.04 % of reading + 1.2 μV	
	(20 to 50) kHz	0.15 % of reading + 1.2 μV	
	(50 to 100) kHz	0.59 % of reading + 1.2 μV	
	(100 to 300) kHz	4.6 % of reading + 2.3 μV	
	300 kHz to 1 MHz	1.5 % of reading + 5.8 μV	
	(1 to 4) MHz	8.1 % of reading + 8.1 μV	
	(10 to 100) mV		
	(1 to 40) Hz	0.013 % of reading + 4.8 μV	
	40 Hz to 1 kHz	0.0097 % 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		



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	(0.1 to 1) V		Agilent 3458A 8.5 Digit Multimeter
	(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 + 2 mV	
	(2 to 4) MHz	4.6 % of reading + 8.1 mV	
	(4 to 8) MHz	4.6 % of reading + 9.2 mV	
	(8 to 10) MHz	17 % of reading + 12 mV	
	(10 to 100) V		
	(1 to 40) Hz	0.024 % of reading + 4.6 mV	
	40 Hz to 1 kHz	0.024 % of reading + 2.3 mV	
	(1 to 20) kHz	0.024 % of reading + 2.3 mV	
	(20 to 50) kHz	0.041 % of reading + 2.3 mV	
	(50 to 100) kHz	0.14 % of reading + 2.3 mV	
(100 to 300) kHz	0.46 % of reading + 12 mV		
300 kHz to 1 MHz	1.7 % of reading + 12 mV		
(100 to 700) V			
(1 to 40) Hz	0.048 % of reading + 46 mV		
40 Hz to 1 kHz	0.048 % of reading + 23 mV		
(1 to 20) kHz	0.071 % of reading + 23 mV		
(20 to 50) kHz	0.19 % of reading + 23 mV		
(50 to 100) kHz	0.35 % of reading + 23 mV		



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	(700 to 1 050) V (1 to 10) Hz (10 to 40) Hz 40 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.034 % of reading + 62 mV 0.03 % of reading + 19 mV 0.03 % of reading + 19 mV 0.11 % of reading + 39 mV 0.16 % of reading + 0.19 V	Fluke 8508A 8.5 Digit Multimeter
AC High Voltage – Measure/Source ¹	(1 to 10) kV (10 to 200) Hz (200 to 450) Hz (450 to 600) Hz (10 to 35) kV (30 to 200) Hz (200 to 450) Hz (450 to 600) Hz	0.14 % of reading + 0.17 V 0.46 % of reading + 0.17 V 0.86 % of reading + 0.17 V 0.11 % of reading + 0.81 V 0.7 % of reading + 0.81 V 1.45 % of reading + 0.81 V	Vitrek 4700 DVM w/ Associated High Voltage Probes
AC High Voltage – Measure/Source ¹	(35 to 70) kV (30 to 100) Hz (100 to 450) Hz (450 to 600) Hz (70 to 100) kV (30 to 100) Hz (100 to 450) Hz (450 to 600) Hz	0.14 % of reading + 1.0 V 0.7 % of reading + 1.0 V 2.9 % of reading + 1.0 V 0.21 % of reading + 1.3 V 1.2 % of reading + 1.3 V 17 % of reading + 1.3 V	Vitrek 4700 DVM w/ Associated High Voltage Probes
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	0.16 % of reading + 4 μV 0.1 % of reading + 4 μV 0.078 % of reading + 4 μV 0.13 % of reading + 4 μV 0.17 % of reading + 5 μV 0.33 % of reading + 10 μV 0.47 % of reading + 20 μV 0.58 % of reading + 20 μV 0.042 % of reading + 4 μV 0.03 % of reading + 4 μV 0.014 % of reading + 4 μV 0.3 % of reading + 4 μV 0.058 % of reading + 5 μV 0.12 % of reading + 10 μV 0.16 % of reading + 20 μV 0.27 % of reading + 20 μV	Fluke 5700A-EP Multiproduct Calibrator



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source ¹	(22 to 220) mV		Fluke 5700A-EP Multiproduct Calibrator
	(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	
	220 mV 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	0.011 % 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		
(22 to 220) V			
(10 to 20) Hz	0.028 % of reading + 4 mV		
(20 to 40) Hz	0.01 % of reading + 1.5 mV		
40 Hz to 20 kHz	0.005 6 % of reading + 0.6 mV		
(20 o 50) kHz	0.009 3 % of reading + 1 mV		
(50 to 100) kHz	0.016 % of reading + 2.5 mV		
(100 to 300) kHz	0.09 % of reading + 16 mV		
(300 to 500) kHz	0.44 % of reading + 40 mV		
500 kHz to 1 MHz	0.8 % of reading + 80 mV		
AC Voltage – Source ¹	(220 to 1 100) V		Fluke 5700A-EP Calibrator w/ Fluke 5725A Amplifier
	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	
	(30 to 50) kHz	0.061 % of reading + 11 mV	
	(50 to 100) kHz	0.23 % of reading + 45 mV	



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Measure ¹	1 kHz Up to 10 pF (10 to 100) pF 100 pF to 25 μF (25 to 100) μF (100 to 1 000) μF	0.47 % of reading + 0.05 pF 0.06 % of reading + 0.05 pF 0.02 % of reading + 0.05 pF 0.03 % of reading 0.24 % of reading	GenRad 1689-9700 RLC Digibridge
Capacitance – Measure	0.1 pF 100 kHz 1 MHz 1 pF 10 kHz 100 kHz 1 MHz 2 MHz 10 pF 1 kHz 10 kHz 100 kHz 1 MHz 2 MHz 100 pF 100 Hz 1 kHz 10 kHz 100 kHz 1 MHz 2 MHz 1 nF 20 Hz 100 Hz 1 kHz 10 kHz 100 kHz 1 MHz 2 MHz	1.4 % of reading 1.8 % of reading 1.4 % of reading 0.37 % of reading 0.44 % of reading 1.1 % of reading 1.4 % of reading 0.28 % of reading 0.28 % of reading 0.3 % of reading 0.75 % of reading 2.1 % of reading 0.23 % of reading 0.18 % of reading 0.21 % of reading 0.23 % of reading 0.3 % of reading 1.8 % of reading 0.3 % of reading 0.1 % of reading 0.1 % of reading 0.1 % of reading 0.1 % of reading 0.14 % of reading 0.53 % of reading	Agilent E4980A LCR Meter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Measure	10 nF		Agilent E4980A LCR Meter
	20 Hz	0.31 % of reading	
	100 Hz	0.12 % of reading	
	1 kHz	0.1 % of reading	
	10 kHz	0.1 % of reading	
	100 kHz	0.1 % of reading	
	1 MHz	0.25 % of reading	
	2 MHz	0.67 % of reading	
	100 nF		
	20 Hz	0.16 % of reading	
	100 Hz	0.1 % of reading	
	1 kHz	0.1 % of reading	
	10 kHz	0.1 % of reading	
	100 kHz	0.18 % of reading	
	1 MHz	0.33 % of reading	
	2 MHz	0.97 % of reading	
	1 μF		
	20 Hz	0.15 % of reading	
	100 Hz	0.09 % of reading	
	1 kHz	0.09 % of reading	
	10 kHz	0.18 % of reading	
	100 kHz	0.25 % of reading	
	1 MHz	0.79 % of reading	
	10 μF		
	20 Hz	0.15 % of reading	
	100 Hz	0.09 % of reading	
	1 kHz	0.16 % of reading	
	10 kHz	0.28 % of reading	
100 kHz	0.73 % of reading		
100 μF			
20 Hz	0.16 % of reading		
100 Hz	0.17 % of reading		
1 kHz	0.29 % of reading		
10 kHz	0.8 % of reading		

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 0.2 % of reading + 0.78 nF 0.2 % of reading + 2.3 nF 0.2 % of reading + 7.8 nF 0.32 % 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 0.59 % of reading + 23 μF 0.86 % of reading + 78 μF	Fluke 5520A/1100 Multiproduct Calibrator
Capacitance – Source ^{1,7} (Fixed Artifacts)	1 kHz 1 nF 2 nF 5 nF 10 nF 20 nF 50 nF 0.1 μF 0.2 μF 0.5 μF 1 μF	0.32 pF 0.59 pF 1.4 pF 2.7 pF 5.4 pF 13 pF 38 pF 76 pF 0.19 nF 0.38 nF	GenRad 1409 Series Standard Capacitors, GenRad 1689-9700 RLC Digibridge
Inductance – Measure ¹	100 Hz to 1 kHz (1 to 10) mH 10 mH to 10 H	0.026 % of reading + 0.1 μH 0.026 % of reading + 1.4 μH	GenRad 1689-9700 RLC Digibridge
Inductance – Measure	1 μH 10 kHz 100 kHz 1 MHz 2 MHz 10 μH 10 kHz 100 kHz 1 MHz 2 MHz	1.6 % of reading 0.36 % of reading 0.27 % of reading 0.66 % of reading 0.37 % of reading 0.20 % of reading 0.20 % of reading 0.30 % of reading	Agilent E4980A LCR Meter



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Inductance – Measure	100 μ H		Agilent E4980A LCR Meter
	1 kHz	0.40 % of reading	
	10 kHz	0.20 % of reading	
	100 kHz	0.12 % of reading	
	1 MHz	0.14 % of reading	
	2 MHz	0.72 % of reading	
	1 mH		
	100 Hz	0.55 % of reading	
	1 kHz	0.18 % of reading	
	10 kHz	0.12 % of reading	
	100 kHz	0.09 % of reading	
	1 MHz	0.23 % of reading	
	2 MHz	0.88 % of reading	
	10 mH		
	20 Hz	0.85 % of reading	
	100 Hz	0.22 % of reading	
	1 kHz	0.09 % of reading	
	10 kHz	0.09 % of reading	
	100 kHz	0.10 % of reading	
	1 MHz	0.35 % of reading	
	2 MHz	1.3 % of reading	
	100 mH		
	20 Hz	0.28 % of reading	
	100 Hz	0.10 % of reading	
	1 kHz	0.09 % of reading	
	10 kHz	0.09 % of reading	
	100 kHz	0.21 % of reading	
	1 MHz	0.88 % of reading	
	1 H		
	20 Hz	0.16 % of reading	
100 Hz	0.09 % of reading		
1 kHz	0.09 % of reading		
10 kHz	0.10 % of reading		
100 kHz	0.31 % of reading		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Inductance – Measure	10 H		Agilent E4980AL LCR Meter
	20 Hz	0.15 % of reading	
	100 Hz	0.10 % of reading	
	1 kHz	0.11 % of reading	
	10 kHz	0.21 % of reading	
	100 kHz	0.69 % of reading	
	100 H		
	20 Hz	0.15 % of reading	
	100 Hz	0.10 % of reading	
	1 kHz	0.15 % of reading	
10 kHz	0.62 % of reading		
AC Resistance – Measure	0.1 Ω		Agilent E4980A LCR Meter
	1 kHz	1.8 % of reading	
	10 kHz	1.6 % of reading	
	100 kHz	1.0 % of reading	
	1 MHz	1.5 % of reading	
	1 Ω		
	20 Hz	0.67 % of reading	
	100 Hz	0.43 % of reading	
	1 kHz	0.33 % of reading	
	10 kHz	0.32 % of reading	
	100 kHz	0.31 % of reading	
	1 MHz	0.38 % of reading	
	2 MHz	0.92 % of reading	
	10 Ω		
	20 Hz	0.29 % of reading	
	100 Hz	0.20 % of reading	
	1 kHz	0.17 % of reading	
	10 kHz	0.19 % of reading	
	100 kHz	0.19 % of reading	
	1 MHz	0.27 % of reading	
	2 MHz	0.67 % of reading	
	100 Ω		
	20 Hz	0.16 % of reading	
	100 Hz	0.09 % of reading	
1 kHz	0.09 % of reading		
10 kHz	0.12 % of reading		
100 kHz	0.12 % of reading		
1 MHz	0.2 % of reading		
2 MHz	0.53 % of reading		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Resistance – Measure	1 kΩ		Agilent E4980A LCR Meter
	20 Hz	0.15 % of reading	
	100 Hz	0.09 % of reading	
	1 kHz	0.09 % of reading	
	10 kHz	0.09 % of reading	
	100 kHz	0.09 % of reading	
	1 MHz	0.14 % of reading	
	2 MHz	0.3 % of reading	
	10 kΩ		
	20 Hz	0.15 % of reading	
	100 Hz	0.09 % of reading	
	1 kHz	0.09 % of reading	
	10 kHz	0.09 % of reading	
	100 kHz	0.1 % of reading	
	1 MHz	0.29 % of reading	
	2 MHz	0.87 % of reading	
	100 kΩ		
	20 Hz	0.17 % of reading	
	100 Hz	0.1 % of reading	
	1 kHz	0.1 % of reading	
	10 kHz	0.17 % of reading	
100 kHz	0.28 % of reading		
1 MHz	0.38 % of reading		
2 MHz	1.3 % of reading		
Inductance – Source ^{1,7} (Fixed Artifacts)	100 μH	25 nH	Standard Inductors characterized with GenRad 1689-9700 RLC Digibridge
	1 mH	0.25 μH	
	10 mH	2.5 μH	
	100 mH	25 μH	
	1 H	0.25 mH	
	10 H	2.5 mH	

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	1.2 °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	0.09 °C	
	(-90 to 0) °C	0.08 °C	
	(0 to 15) °C	0.08 °C	
	(15 to 890) °C	0.06 °C	
	(890 to 1 000) °C	0.07 °C	
Type J			
(-210 to -180) °C	0.15 °C		
(-180 to -120) °C	0.12 °C		
(-120 to -50) °C	0.09 °C		
(-50 to 990) °C	0.08 °C		
(990 to 1 200) °C	0.09 °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	0.09 °C		
(1 000 to 1 372) °C	0.1 °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		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	0.09 °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	0.023 % of reading + 19 μV	
into 1 MΩ	(-200 to 200) V	0.023 % of reading + 19 μV	



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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 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	Fluke 9500B Oscilloscope Calibrator
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	
Scope – Time Markers ¹ 100 mVp-p to 1 Vp-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	
Sine Wave	450.5 ps to 9.009 ns	0.19 μs/s	Fluke 9500B Oscilloscope Calibrator
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	≥ 350 ps	28 ps	
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 35 ps	Fluke 9500B Oscilloscope Calibrator with Fluke 9530 Active Head
10 Hz to 1 MHz	25 mVp-p to 2 Vp-p 70 ps (Nominal)	24 ps	
Scope Rise Time – Source ^{1,4} (into 50 Ω) 10 Hz to 1 MHz	425 mVp-p to 2 Vp-p 25 ps (Nominal)	6.7 ps	Fluke 9500B Oscilloscope Calibrator with Fluke 9530 Active Head
Scope Levelled Sine Wave – Source ¹ (50 kHz Ref. Frequency) into 50 Ω	5 mVp-p to 5 Vp-p 50 kHz to 10 MHz	1.2 % of reading	Fluke 9500B Oscilloscope Calibrator with Fluke 9530 Active Head



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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
AC Voltage Harmonics – Source ^{1,3} Carrier Range: 45 V Carrier Range: 90 V Carrier Range: 180 V	Up to 13.5 V (16 to 850) Hz 850 Hz to 6.5 kHz Up to 27 V (16 to 850) Hz 850 Hz to 6.5 kHz Up to 54 V (16 to 850) Hz 850 Hz to 6.5 kHz	67 μV/V + 2 mV 0.52 mV + 2 mV 69 μV/V + 2 mV 0.52 mV + 2 mV 69 μV/V + 6 mV 0.52 mV + 6 mV	Fluke 6105A Electrical Power Quality Calibrator
AC Voltage Harmonics – Source ^{1,3} Carrier Range: Up to 360 V Carrier Range: 650 V Carrier Range: 1 008 V	Up to 108 V (16 to 850) Hz 850 Hz to 6.5 kHz Up to 195 V (16 to 850) Hz 850 Hz to 6.5 kHz Up to 302 V (16 to 850) Hz 850 Hz to 6.5 kHz	69 μV/V + 13 mV 0.52 mV/V + 13 mV 70 μV/V + 22 mV 0.52 mV/V + 22 mV 70 μV/V + 33 mV 0.52 mV/V + 33 mV	Fluke 6105A Electrical Power Quality Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current Harmonics – Source ^{1,3} Carrier Range: 0.25 A Carrier Range: 0.5 A Carrier Range: 1 A Carrier Range: 2 A Carrier Range: 5 A Carrier Range: 10 A Carrier Range: 20 A	Up to 75 mA (16 to 850) Hz 850 Hz to 6.5 kHz Up to 0.15 A (16 to 850) Hz 850 Hz to 6.5 kHz Up to 0.3 A (16 to 850) Hz 850 Hz to 6.5 kHz Up to 0.6 A (16 to 850) Hz 850 Hz to 6.5 kHz Up to 1.5 A (16 to 850) Hz 850 Hz to 6.5 kHz Up to 3 A (16 to 850) Hz 850 Hz to 6.5 kHz Up to 6 A (16 to 850) Hz 850 Hz to 6.5 kHz	61 μ A/A + 21 μ A 0.46 mA/A + 22 μ A 70 μ A/A + 21 μ A 0.46 mA/A + 23 μ A 70 μ A/A + 29 μ A 0.46 mA/A + 29 μ A 70 μ A/A + 0.1 mA 0.46 mA/A + 0.1 mA 70 μ A/A + 0.1 mA 0.46 mA/A + 0.1 mA 74 μ A/A + 0.29 mA 0.46 mA/A + 0.29 mA 75 μ A/A + 0.45 mA 0.46 mA/A + 0.45 mA	Fluke 6105A Electrical Power Quality Calibrator
LF Phase – Source ¹	(0 to 90) ° (10 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.09 ° 0.2 ° 0.39 ° 1.9 ° 3.9 ° 7.8 °	Fluke 5520A/1100 Multiproduct Calibrator
DC Power – Source ¹ (0.33 to 330) mA (0.33 to 3) A (3 to 20.5) A	11 μ W to 330 W 11 W to 3 kW 99 mW to 20.9 kW	0.018 % of reading 0.017 % of reading 0.054 % of reading	Fluke 5520A/1100 Multiproduct Calibrator



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Power – Source ^{1,5} PF = 1 3.3 mA to 3 A 3.3 mA to 20.5 A 33 mA to 3 A 33 mA to 20.5 A (3 to 20.5) A	(10 to 45) Hz 0.11 mW to 99 W	0.18 % of reading	Fluke 5520A/11 Multiproduct Calibrator
	(45 to 65) Hz 0.11 mW to 20.9 kW	0.14 % of reading	
	(65 to 500) Hz 11 mW to 3.06 kW	0.16 % of reading	
	500 Hz to 1 kHz 11 mW to 20.9 kW	0.17 % of reading	
	(65 to 500) Hz 9.9 W to 20.9 kW	0.16 % of reading	
AC Power – Source ^{1,5} PF = 1 (0.5 to 20) A	(65 to 850) Hz 23 W to 13 kW	0.024 % of reading	Fluke 6105A Electrical Power Quality Calibrator

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Attenuation – Source ¹	DC to 12.4 GHz		Agilent 8496H Programmable Attenuator w/ Type -N
	1 dB	0.3 dB	
	2 dB	0.3 dB	
	3 dB	0.4 dB	
	4 dB	0.4 dB	
	5 dB	0.5 dB	
	6 dB	0.5 dB	
	7 dB	0.6 dB	
	8 dB	0.6 dB	
	9 dB	0.6 dB	
	10 dB	0.6 dB	
11 dB	0.7 dB		

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Attenuation – Source ¹	(12.4 to 18) GHz		Agilent 8496H Programmable Attenuator w/ Type -N
	1 dB	0.7 dB	
	2 dB	0.7 dB	
	3 dB	0.7 dB	
	4 dB	0.7 dB	
	5 dB	0.8 dB	
	6 dB	0.8 dB	
	7 dB	0.8 dB	
	8 dB	0.8 dB	
	9 dB	0.9 dB	
	10 dB	0.9 dB	
11 dB	0.5 dB		
Attenuation – Source ¹	DC to 12.4 GHz		Agilent 8496H Programmable Attenuator w/ Type -N
	10 dB	0.5 dB	
	20 dB	0.7 dB	
	30 dB	0.9 dB	
	40 dB	1.2 dB	
	50 dB	1.5 dB	
	60 dB	1.8 dB	
	70 dB	2.1 dB	
	80 dB	2.4 dB	
	90 dB	2.7 dB	
	100 dB	3 dB	
	110 dB	3.3 dB	
	(12.4 to 18) GHz		
	10 dB	0.6 dB	
	20 dB	0.8 dB	
	30 dB	1.2 dB	
	40 dB	1.6 dB	
	50 dB	2 dB	
	60 dB	2.4 dB	
	70 dB	2.8 dB	
	80 dB	3.2 dB	
90 dB	3.6 dB		
100 dB	4 dB		
110 dB	4.4 dB		
RF Absolute Power – Measure ¹	10 Hz to 20 kHz (-10 to 30) dBm	0.13 % of reading	Fluke 8846A 6.5 Digit Multimeter
RF Absolute Power – Measure ¹	9 kHz to 18 GHz (-60 to 20) dBm	2.6 % of reading	Agilent E9304A-H18 RF Power Sensor w/ RF Power Meter



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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power – Measure ¹	(18 to 40) GHz (-70 to -30) dBm	3.8 % of reading	Agilent 8487D RF Power Sensor w/ RF Power Meter
	(40 to 50) GHz (-70 to -30) dBm	5.5 % of reading	
RF Absolute Power – Measure ¹	(18 to 40) GHz (-30 to 20) dBm	4.4 % of reading	Agilent 8487D RF Power Sensor w/ RF Power Meter
	(40 to 50) GHz (-30 to 20) dBm	5.5 % of reading	
RF Absolute Power – Measure ¹	30 MHz to 50 GHz (20 to 30) dBm	4.8 % of reading	Agilent E5532A-550 RF Power Sensor Module w/ RF Power Meter
RF Absolute Power – Source ¹	(-70 to -10) dBm		Agilent E8257D Analog Signal Generator
	250 kHz to 2 GHz	0.8 dB	
	(2 to 20) GHz	1.1 dB	
	(20 to 40) GHz	1.2 dB	
	(40 to 50) GHz	1.8 dB	
	(-10 to 0) dBm		
RF Absolute Power – Source ¹	250 kHz to 2 GHz	0.7 dB	Agilent E8257D Analog Signal Generator
	(2 to 20) GHz	0.9 dB	
	(20 to 40) GHz	1.1 dB	
	(40 to 50) GHz	1.1 dB	
	(0 to 10 dBm)		
	250 kHz to 2 GHz	0.7 dB	
RF Absolute Power – Source ¹	(2 to 20) GHz	0.9 dB	Agilent E8257D Analog Signal Generator
	(20 to 40) GHz	1.1 dB	
	(40 to 50) GHz	1.5 dB	
	(10 to 14 dBm)		
	250 kHz to 2 GHz	0.7 dB	
	(2 to 20) GHz	0.9 dB	
RF Absolute Power – Source ¹	(20 to 40) GHz	1.2 dB	Agilent E8257D Analog Signal Generator
	(14 to 19 dBm)		
	250 kHz to 2 GHz	0.9 dB	
RF Absolute Power – Source ¹	(2 to 20) GHz	0.9 dB	Agilent E8257D Analog Signal Generator
	(20 to 40) GHz	1.2 dB	
	(20 to 40) GHz	1.2 dB	



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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Relative Power – Measure ¹ (Tuned RF Level)	100 kHz to 50 GHz		Agilent E4448A Spectrum Analyzer
	(-10 to 0) dB	0.02 dB	
	(-20 to -10) dB	0.02 dB	
	(-30 to -20) dB	0.03 dB	
	(-40 to -30) dB	0.04 dB	
	(-50 to -40) dB	0.04 dB	
	(-60 to -50) dB	0.09 dB	
	(-70 to -60) dB	0.10 dB	
	(-80 to -70) dB	0.14 dB	
	(-90 to -80) dB	0.15 dB	
S11/S22 Reflection Magnitude – Measure ¹ (Linear)	100 kHz to 45 GHz		Agilent E5071C Network Analyzer (Corrected with Agilent 85032F Calibration Kit)
	(-100 to -90) dB	0.16 dB	
	(-110 to -100) dB	0.29 dB	
S11/S22 Reflection Magnitude – Measure ¹ (Linear)	100 kHz to 31.15 GHz		Agilent E5235A Network Analyzer (Corrected with Agilent 85056K Calibration Kit)
	(-120 to -110) dB	0.29 dB	
	(-130 to -120) dB	0.29 dB	
	(-130 to -120) dB	0.29 dB	
S12/S21 Transmission Magnitude – Measure ¹ (dB)	9 kHz to 10 MHz		Agilent E5071C Network Analyzer (Corrected with Agilent 85032F Calibration Kit)
	(0 to 0.5) lin	0.009	
	(0.5 to 1) lin	0.019	
	(0.5 to 1) lin	0.022	
S12/S21 Transmission Magnitude – Measure ¹ (dB)	10 MHz to 9 GHz		Agilent E5071C Network Analyzer (Corrected with Agilent 85032F Calibration Kit)
	(0 to 0.5) lin	0.012	
	(0.5 to 1) lin	0.022	
	(0.5 to 1) lin	0.022	

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
S12/S21 Transmission Magnitude – Measure ¹ (dB)	(10 to 500) MHz (-30 to 0) dB (-60 to -30) dB 500 MHz to 2 GHz (-30 to 0) dB (-60 to -30) dB (2 to 50) GHz (-30 to 0) dB (-60 to -30) dB	0.07 dB 1.6 dB 0.05 dB 0.18 dB 0.14 dB 0.55 dB	Agilent E5235A Network Analyzer (Corrected with Agilent 85056K Calibration Kit)
Amplitude Modulation – AM Depth Measure ¹ Rate: 100 kHz to 20 MHz 10 MHz to 3 GHz (3 to 26.5) GHz (26.5 to 31.15) GHz	50 Hz to 10 kHz (5 to 99) % Depth 50 Hz to 100 kHz (5 to 20) % Depth (20 to 99) % Depth 50 Hz to 100 kHz (5 to 20) % Depth (20 to 99) % Depth 50 Hz to 100 kHz (5 to 20) % Depth (20 to 99) % Depth	0.9 % Depth 0.8 % Depth 2.6 % Depth 1.6 % Depth 4.5 % Depth 2.1 % Depth 6.8 % Depth	Agilent E4448A Spectrum Analyzer
Amplitude Modulation – AM Depth Measure ¹ Rate: (31.15 to 50) GHz	50 Hz to 100 kHz (5 to 20) % Depth (20 to 99) % Depth	6 % Depth 26 % Depth	Agilent E4448A Spectrum Analyzer
Amplitude Modulation Distortion – Measure ¹ 100 kHz to 10 kHz 10 MHz to 26.5 GHz (26.5 to 50) GHz	20 Hz to 1 kHz > 1 % > 3 % 20 Hz to 1 kHz > 1 % > 3 % 20 Hz to 1 kHz > 1 % > 3 % > 5 %	0.85 % of reading 0.42 % of reading 1 % of reading 0.5 % of reading 6.2 % of reading 2 % of reading 1.5 % of reading	Agilent E4448A Spectrum Analyzer
Amplitude Modulation – AM Depth – Source ¹ 250 kHz to 50 GHz	(0 to 90) % Depth	6.6 % Depth	Agilent E8257D Analog Signal Generator



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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency Modulation Deviation – Measure ¹ Rate: 250 kHz to 10 MHz	20 Hz to 10 kHz Dev/Rate > 0.2 Dev/Rate > 1.2	1.5 % Deviation 1 % Deviation	Agilent E4448A Spectrum Analyzer
10 MHz to 6.6 GHz	50 Hz to 200 kHz Dev/Rate > 0.2 Dev/Rate > 0.45	1.5 % Deviation 1 % Deviation	
(6.6 to 13.2) GHz	50 Hz to 200 kHz Dev/Rate > 0.2 Dev/Rate > 8	2.5 % Deviation 1 % Deviation	
(13.2 to 31.15) GHz	50 Hz to 200 kHz Dev/Rate > 0.2 Dev/Rate > 16	3.8 % Deviation 1 % Deviation	
(31.5 to 50) GHz	50 Hz to 200 kHz Dev/Rate > 0.2 Dev/Rate > 32	8.5 % Deviation 1 % Deviation	
Frequency Modulation Distortion – Measure ¹ 1 MHz to 6.6 GHz	20 Hz to 1 kHz Dev 500 Hz to 2 kHz Dev ≥ 2 kHz	0.3 % of reading 0.11 % of reading	Agilent E4448A Spectrum Analyzer
Frequency Modulation Distortion – Measure ¹ (6.6 to 13.2) GHz	20 Hz to 1 kHz Dev > 2.3 kHz Dev ≥ 4.5 kHz	0.3 % of reading 0.11 % of reading	Agilent E4448A Spectrum Analyzer
(13.2 to 31.15) GHz	20 Hz to 1 kHz Dev > 2.7 kHz Dev ≥ 6 kHz	0.31 % of reading 0.12 % of reading	
(31.5 to 50) GHz	20 Hz to 1 kHz Dev > 4 kHz Dev ≥ 12 kHz	0.32 % of reading 0.14 % of reading	
Frequency Modulation – Deviation Source ¹ 250 kHz to 50 GHz	DC to 10 MHz Dev ≤ 128 MHz	3.9 % Deviation	Agilent E8257D Analog Signal Generator



ANSI National Accreditation Board

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Phase Modulation Deviation – Measure ¹ Rate: 100 kHz to 6.6 GHz (6.6 to 13.2) GHz (13.2 to 26.5) GHz (26.5 to 31.15) GHz (31.15 to 50) GHz	> 0.7 rad > 0.3 rad > 2 rad > 0.6 rad > 4.0 rad > 1.2 rad > 4 rad > 1.3 rad > 8 rad > 2.4 rad	1.1 % Deviation 3.2 % Deviation 1.1 % Deviation 3.2 % Deviation 1.1 % Deviation 3.2 % Deviation 1.1 % Deviation 3.2 % Deviation 1.1 % Deviation 3.2 % Deviation	Agilent E4448A Spectrum Analyzer
Phase Modulation Distortion – Measure ¹ 1 MHz to 6.6 GHz (6.6 to 13.2) GHz	(20 to 500) Hz > 0.8 rad ≥ 2.5 rad 500 Hz to 1 kHz > 0.4 rad ≥ 1.0 rad (20 to 500) Hz > 1.8 rad ≥ 5.5 rad 500 Hz to 1 kHz ≥ 0.8 rad ≥ 2.5 rad	0.31 % of reading 0.13 % of reading 0.31 % of reading 0.13 % of reading 0.31 % of reading 0.13 % of reading 0.31 % of reading 0.13 % of reading	Agilent E4448A Spectrum Analyzer
Phase Modulation Distortion – Measure ¹ (13.2 to 31.15) GHz (31.15 to 50) GHz	(20 to 500) Hz > 3.5 rad ≥ 10 rad (20 to 500) Hz > 7.5 rad ≥ 19 rad 500 Hz to 1 kHz > 3 rad ≥ 8 rad	0.31 % of reading 0.13% of reading 0.31 % of reading 0.13 % of reading 0.31 % of reading 0.13 % of reading	Agilent E4448A Spectrum Analyzer



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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Phase Modulation Distortion – Source ¹	(250 to 500) MHz (0 to 10) rad	5.8 % of reading	Agilent E8257D Analog Signal Generator
	500 MHz to 1 GHz (0 to 20) rad	5.8 % of reading	
	(1 to 2) GHz (0 to 40) rad	5.8 % of reading	
	(2 to 3.2) GHz (0 to 80) rad	5.8 % of reading	
	(3.2 to 10) GHz (0 to 160) rad	5.8 % of reading	
	(10 to 20) GHz (0 to 320) rad	5.8 % of reading	
	(20 to 40) GHz (0 to 640) rad	5.8 % of reading	
	(40 to 50) GHz (0 to 1 280) rad	5.8 % of reading	
Single Sideband Phase Noise – Measure ¹ CW Frequency:	Markers:		Agilent E4448A Spectrum Analyzer
3 Hz to 3 GHz	100 Hz to 1 MHz	0.6 dB	
(3 to 6.6) GHz	100 Hz to 1 MHz	1 dB	
(6.6 to 22) GHz	100 Hz to 1 MHz	1.6 dB	
(22 to 26.8) GHz	100 Hz to 1 MHz	1.7 dB	
(26.8 to 31.15) GHz	100 Hz to 1 MHz	1.1 dB	
(31.15 to 50) GHz	100 Hz to 1 MHz	1.4 dB	
Total Harmonic Distortion – Measure ¹ (-100 to 0) dB	10 Hz to 100 kHz 20 Hz to 20 kHz (20 to 100) kHz	8.4 % of reading 1.1 dB 2 dB	Agilent U8903A Audio Analyzer
Total Harmonic Distortion – Measure ¹ Rate: 5 Hz to 600 kHz Level: (0.3 to 100) %	10 Hz to 1 MHz (1 to 3) MHz	3 % of reading 6 % of reading	Agilent 334A Distortion Analyzer

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Angle Measuring Devices ² (Protractors, Inclinometers, Squares, Angle Gages)	5° (5 to 20)° (20 to 35)° (35 to 45)° (45 to 60)° (60 to 75)° (75 to 85)°	1.4" 2.1" 3.5" 4.9" 8.3" 18" 54"	10 in Sine Bar, Gage Blocks, Surface Plate
Angle Measuring Devices ² (Protractors, Inclinometers, Squares, Angle Gages)	≥ 90°	1.9"	Master Square, Surface Plate
Micrometers ^{1,2} Outside, Inside, Depth	(0.05 to 1) in (1 to 9) in	(13 + 1L) μin (9 + 4L) μin	Grade 0 Gage Blocks
	(5 to 15) in (15 to 40) in	(11 + 4L) μin (16 + 4L) μin	Long Gage Blocks
Anvil Flatness	Up to 1 inD	3.9 μin	Optical Flats
Anvil Parallelism	Up to 1 inD	6.3 μin	Optical Parallels
Calipers ^{1,2} Outside, Inside, Depth, Step	(0.05 to 1) in (1 to 9) in	(13 + 1L) μin (9 + 4L) μin	Grade 0 Gage Blocks
	(5 to 15) in (15 to 40) in	(11 + 4L) μin (16 + 4L) μin	Long Gage Blocks
Linear Displacement ²	Up to 12 ft	(1 + 2.1L) μin	Laser Interferometer
Dial Indicators ^{1,2}	Up to 1 in (1 to 6) in	(10 + 2L) μin (5 + 6L) in	Gage Blocks
Length – Single Axis ² Outside Dimension	Up to 1 in (1 to 7) in (7 to 12) in	(6.1 + 1L) μin (4.5 + 3.5L) μin (2 + 4L) μin	Universal Length Measuring Machine
Inside Dimension	(0.04 to 1) in (1 to 2.5) in (2.5 to 10) in (10 to 14) in	(9 + 1L) μin (10 + 3L) μin (15 + 3L) μin (26 + 3L) μin	

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Length – Single Axis ² Outside Dimension	Up to 1 in (1 to 4) in (4 to 24) in	13 μin (10 + 3L) μin (10 + 4.5L) μin	24 in Laser Length Measuring Machine
Height Measuring Equipment ²	(0.05 to 1) in (1 to 9) in (5 to 15) in (15 to 40) in	(13 + 1L) μin (9 + 4L) μin (11 + 4L) μin (16 + 4L) μin	Gage Blocks, Surface Plate
Rulers ²	Up to 12 in (12 to 26) in	(130 + 10L) μin (80 + 15L) μin	OGP Flash-500 Vision System
Measuring Tapes and Rulers ²	Up to 1 ft (1 to 3) ft (3 to 1 000) ft	(460 + 3L) μin (390 + 9L) μin (20L) μin	Accu-Gage Single Axis Vision System
Plug Gages ² (Outside Diameter)	Up to 1 in (1 to 7) in	12 μin (10 + 3L) μin	Universal Length Measuring Machine
Pin Gages ² (Outside Diameter)	(0.003 to 1) in	30 μin	Laser Micrometer
Laser Micrometers ^{1,2}	Up to 0.1 in (0.1 to 0.4) in (0.4 to 1) in	13 μin 8 μin (11 + 5L) μin	Characterized Master Pin Gages
Threaded Plugs ² Pitch Diameter – 60° Thread	Up to 1 in (1 to 4) in (4 to 7) in	79 μin 80 μin 83 μin	Universal Length Measuring Machine, Thread Wires
Major Diameter	Up to 1 in (1 to 7) in	13 μin (10 + 3L) μin	Universal Length Measuring Machine
Step Height	Up to 1 in	32 μin	Gage Probe, Amplifier, Gage Blocks
Threaded Rings Inner Pitch Diameter	Up to 1 in (1 to 4) in (4 to 7) in	79 μin 80 μin 83 μin	Master Plug Uncertainty
Plain Ring Gages ² Inside Diameter	(0.04 to 1) in (1 to 2.5) in (2.5 to 10) (10 to 14) in	(9 + 1L) μin (10 + 3L) μin (15 + 3L) μin (26 + 3L) μin	Universal Length Measuring Machine

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Squareness	Up to 4.5 in	2.4 μin/in	Gage Amplifier with Probe, Grade AA Surface Plate, Cylindrical Square
Parallelism Physical Size Up to 36 in	Up to 0.05 in	41 μin	Gage Amplifier with Probe, Grade AA Surface Plate
Straightness Physical Size Up to 36 in	Up to 0.05 in	52 μin	Gage Amplifier with Probe, Grade AA Surface Plate
Flatness ² Physical Size Up to 3 inD Up to 36 inD	Up to 250 μin	4.5 μin	Optical Flat
	Up to 0.05 in	36 μin	Gage Amplifier with Probe, Grade AA Surface Plate

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Force Measuring Equipment ¹	(0.03 to 600) lbf	0.017 % of reading	NIST Class F Weights
Force Measuring Equipment – Tension ¹	Up to 500 lbf (500 to 10 000) lbf (10 000 to 25 000) lbf (25 000 to 100 000) lbf	0.024 % of reading + 0.11 lbf 0.024 % of reading + 0.51 lbf 0.024 % of reading + 4.8 lbf 0.024 % of reading + 6.4 lbf	Load Cells
Force Measuring Equipment – Compression ¹	Up to 500 lbf (500 to 2 000) lbf (2 000 to 10 000) lbf (10 000 to 25 000) lbf (25 000 to 100 000) lbf	0.024 % of reading + 0.04 lbf 0.025 % of reading + 0.14 lbf 0.023 % of reading + 0.51 lbf 0.024 % of reading + 4.5 lbf 0.023 % of reading + 6.4 lbf	Load Cells



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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Mass Determination (SI)	30 kg	7.9 mg	Echelon II
	25 kg	6.9 mg	
	20 kg	6.5 mg	
	10 kg	2.8 mg	
	5 kg	2 mg	
	3 kg	1.5 mg	
	2 kg	0.56 mg	
	1 kg	0.27 mg	
	500 g	0.12 mg	
	300 g	54 µg	
	200 g	56 µg	
	100 g	39 µg	
	50 g	11 µg	
	30 g	9.3 µg	
20 g	7.2 µg		
10 g	8.2 µg		
Mass Determination (SI)	5 g	4.5 µg	Echelon II
	3 g	4.4 µg	
	2 g	4.7 µg	
	1 g	4.2 µg	
	500 mg	2.3 µg	
	300 mg	2.3 µg	
	200 mg	2.3 µg	
	100 mg	2.3 µg	
	50 mg	2.3 µg	
	30 mg	2.3 µg	
	20 mg	2.3 µg	
	10 mg	2.3 µg	
	5 mg	2.3 µg	
	3 mg	2.3 µg	
2 mg	2.3 µg		
1 mg	2.3 µg		



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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Mass Determination (SI)	50 kg	31 mg	Echelon III
	30 kg	24 mg	
	25 kg	21 mg	
	20 kg	17 mg	
	10 kg	5.2 mg	
	5 kg	4.7 mg	
	3 kg	3.1 mg	
	2 kg	1.6 mg	
	1 kg	0.8 mg	
	500 g	0.38 mg	
	300 g	0.23 mg	
	200 g	0.16 mg	
	100 g	93 µg	
	50 g	38 µg	
	30 g	26 µg	
	20 g	24 µg	
	10 g	17 µg	
5 g	11 µg		
3 g	11 µg		
2 g	12 µg		
1 g	11 µg		
Mass Determination (SI)	500 mg	4.4 µg	Echelon III
	300 mg	4.4 µg	
	200 mg	4.4 µg	
	100 mg	4.4 µg	
	50 mg	4.4 µg	
	30 mg	4.4 µg	
	20 mg	4.4 µg	
	10 mg	4.4 µg	
	5 mg	4.4 µg	
	3 mg	4.4 µg	
	2 mg	4.4 µg	
	1 mg	4.4 µg	

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Mass Determination (Avoirdupois)	50 lb 30 lb 20 lb 10 lb 5 lb 3 lb 2 lb 1 lb 8 oz 4 oz 2 oz 1 oz 0.5 oz	17 mg 5.3 mg 5.7 mg 3.3 mg 1.7 mg 1.7 mg 0.5 mg 0.25 mg 0.17 mg 95 µg 42 µg 29 µg 23 µg	Echelon III
Torque Tools ¹	15 ozf·in to 2 000 lbf·ft	1 % of reading	CDI Torque Measuring System
Torque Transducers, Torque Analyzers ⁸	(5 to 100) ozf·in (5 to 100) lbf·in (100 to 1 000) lbf·in (50 to 600) lbf·ft	0.06 % of reading 0.033 % of reading 0.015 % of reading 0.05 % of reading	Torque Wheels, Torque Arms, Master Weights
Torque Angle ¹	(0 to 35)°	0.35°	Torque Angle Generator
Balances ^{1,6} Metric (SI)	(1 to 500) mg 500 mg to 5 g (5 to 20) g (20 to 30) g 30 g to 5 kg (5 to 50) kg	6.3 µg 0.022 mg 0.033 mg 0.51 mg 0.000 19 % of reading 0.000 2 % of reading	ASTM E617 Class 1 (characterized) weights and internal calibration procedure utilized for the calibration of the weighing system.
Balances ^{1,6} Metric (SI)	(1 to 500) mg 500 mg to 5 g (5 to 20) g (20 to 30) g 30 g to 50 kg	12 µg 4 µg 60 µg 90 µg 0.000 32 % of reading	ASTM E617 Class 1 (non-characterized) weights and internal calibration procedure utilized for the calibration of the weighing system.
Balance/Scales ^{1,6} Avoirdupois	(0.5 to 16) oz (16 to 24) oz (24 to 29) oz (29 to 31) oz 1 lb (2 to 1 000) lb	0.024 % of reading 0.017 % of reading 0.014 % of reading 0.012 % of reading 0.018 % of reading 0.012 % of reading	NIST Class F weights (non-characterized) 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
Absolute Pressure – Source ¹	(0 to 14.7) psia (14.7 to 139.7) psia (139.7 to 2 514.7) psia	0.002 5 psi 0.001 % of reading + 0.007 5 psi 0.007 % of reading	Fluke/Ruska 7250xi Pressure Controller/Calibrator
Pressure – Source Pneumatic ¹	(-14.7 to 0) psig (0 to 125) psig (125 to 2 500) psig	0.001 3 psi 0.001 4 % of reading + 0.007 psi 0.007 % of reading	Fluke/Ruska 7250xi Pressure Controller/Calibrator
Pressure – Source Pneumatic ¹	(-60 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 + 0.000 15 inH ₂ O 0.002 2 inH ₂ O 0.009 % of reading + 0.000 15 inH ₂ O 0.006 7 inH ₂ O 0.009 % of reading + 0.000 15 inH ₂ O	Fluke/DHI PPC4-ui Pressure Measurement System
Pressure – Source Pneumatic ¹	Up to 6 000 psig	0.72 psi	Comparison to Mensor 2101 Digital Pressure Indicator
Pressure – Source Pneumatic ¹	Up to 10 000 psig	1.2 psi	Comparison to Mensor CPR2550 Digital Pressure Indicator
Pressure – Source Hydraulic ¹	(5 to 1 500) psig (1 500 to 15 000) psig	0.008 % of reading 0.008 % of reading	Ametek T-150 Dead Weight Tester
Pressure – Source Hydraulic ¹	(1 000 to 25 000) psig	15 psi	Comparison to Heise 901B Digital Pressure Indicator
Pressure – Source Hydraulic ¹	(500 to 40 000) psig	0.006 3 % of reading	Fluke/Ruska 2450 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 90) % RH	1.3 % RH	Vaisala HMI41/HMP46 Thermohygrometer

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 (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	Thunder Scientific 2500 Two-Pressure Humidity Generator
Temperature – Measure ¹	(-195 to 660) °C	0.003 % of reading + 0.009 °C	Hart 5628 PRT w/ Black Stack Thermometer Indicator
Temperature – Measure ¹	(600 to 1 000) °C (1 000 to 1 200) °C	0.93 °C 1.2 °C	Accu-Mac AM1210 Type S Reference Thermocouple w/ Hart 2565 Thermocouple Module and Black Stack
Temperature – Source (Thermocouple Probes, RTD's, Liquid-in-Glass)	(-80 to 0) °C (0 to 100) °C (100 to 200) °C (200 to 300) °C	0.003 % of reading + 0.014 °C 0.003 % of reading + 0.017 °C 0.003 % of reading + 0.025 °C 0.003 % of reading + 0.035 °C	Hart 5628 PRT w/ Black Stack and Fluke 7381, 7321, and 6331 Baths
Temperature – Source (Thermocouple Probes, RTD's)	(300 to 425) °C (425 to 660) °C	0.003 % of reading + 0.043 °C 0.003 % of reading + 0.06 °C	Hart 5628 PRT w/ Black Stack and Fluke 9173 Dry Well
Temperature – Source (Thermocouple Probes)	(660 to 1 200) °C	3.1 °C	Accu-Mac AM1210 Type S Reference Thermocouple w/ Hart 2565 Thermocouple Module, Black Stack and Furnace

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Reference	10 MHz	3.7 pHz/Hz	GPS, Rubidium Frequency Oscillator

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Measure	1 Hz to 10 kHz 10 kHz to 225 MHz	1.4 nHz/Hz + 4.5 μHz 1.4 nHz/Hz	Function Generator, Rubidium Frequency Oscillator
Frequency – Source (Sine, Square, Triangle)	1 Hz to 80 MHz	58 nHz/Hz	Function Generator, Rubidium Frequency Oscillator
Period – Measure	(1 to 100) s	45 μs	Function Generator, Rubidium Frequency Oscillator
Period – Source	(1 to 100) s	58 μs/s	Function Generator, Rubidium Frequency Oscillator
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	0.039 % of reading + 78 ns 0.62 % of reading + 78 ns 0.001 6 % of reading + 78 ns 0.62 % of reading + 78 ns 0.039 % of reading + 78 ns	Fluke 5522A Multiproduct Calibrator
Rotational Speed – Measure ^{1,2}	(2 to 999) rpm (999 to 8 300) rpm (8 300 to 25 000) rpm (25 000 to 100 000) rpm	0.06 % of reading + 0.12 rpm 1.2 rpm 2.3 rpm 0.007 % of reading + 1.2 rpm	Comparison to Non-contact Laser Tachometer
Non-contact Tachometers ¹	(0.01 to 1 000) rpm (1 000 to 10 000) rpm (10 000 to 100 000) rpm (100 000 to 200 000) rpm	0.000 2 % of reading 0.000 4 % of reading 0.003 % of reading 0.006 % of reading	Function Generator, Rubidium Frequency Oscillator
Time Interval – Measure ¹	Up to 24 hr	1 s/d + 0.2 s	Comparison to Stopwatch
Stopwatches/Timers	Up to 19.99 s/d	59 ms/d	Vibrograf 4500 Timometer



ANSI National Accreditation Board

DIMENSIONAL MEASUREMENT

1 Dimensional

Specific Tests and / or Properties Measured	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Fixtures, Gauging, Dies, Molds ² Single Axis Length Outside Dimensions Inside Dimensions	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 + 1L) μin (4.5 + 3.5L) μin (2 + 4L) μin (9 + 1L) μin (10 + 3L) μin (15 + 3L) μin (26 + 3L) μin	Universal Length Measuring Machine utilized as the Reference for 1D Geometric Measurements.

2 Dimensional

Specific Tests and / or Properties Measured	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Angle Measurements	Up to 12 in (0 to 360)°	0.015°	OGP Flash-500 Vision System utilized for 2D Angle Measurements.
Length Measurements ² (X-Y Axis)	Up to 19 in x 17 in Up to 12 in (12 to 26) in	(130 + 10L) μin (80 + 15L) μin	OGP Flash-500 Vision System utilized for 2D Dimensional Measurements.

3 Dimensional

Specific Tests and / or Properties Measured	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Fixtures, Gauging, Dies, Molds Volumetric Measurement (X, Y, Z Axes)	1 in x 1 in x 1 in 3 in x 3 in x 3 in 6 in x 6 in x 6 in 12 in x 12 in x 12 in	250 μin 260 μin 260 μin 270 μin	Global Advantage 7.10.7 Coordinate Measuring Machine utilized for 3D Measurements.

3 Dimensional

Specific Tests and / or Properties Measured	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Fixtures, Gauging, Dies, Molds Volumetric Measurement (X, Y, Z Axes)	18 in x 18 in x 18 in 24 in x 24 in x 24 in 27 in x 39 in x 27 in	300 μ in 320 μ in 360 μ in	Global Advantage 7.10.7 Coordinate Measuring Machine utilized for 3D Measurements.

Calibration and Measurement Capability (CMC) is expressed in terms of the measurement parameter, measurement range, expanded uncertainty of measurement and reference standard, method, and/or equipment. The expanded uncertainty of measurement is expressed as the standard uncertainty of the measurement multiplied by a coverage factor of 2 ($k=2$), corresponding to a confidence level of approximately 95%.

Notes:

1. On-site calibration service is available for this parameter, since on-site conditions are typically more variable than those in the laboratory, larger measurement uncertainties are expected on-site than what is reported on the accredited scope.
2. L = length in inches; D = diameter in inches; " = arc-second; rpm = revolutions per minute.
3. As frequency & amplitude deviate from the listed values, uncertainty may be higher than stated. If needed, contact the laboratory for more information regarding uncertainties at frequency and range combinations other than the ones shown.
4. The stated uncertainty is the laboratory's ability to source a fast rise pulse that is approximately 500 ps, 150 ps, or 70 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 UUT. The known source rise time is mathematically removed from the total observed UUT rise time.
5. 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.
6. 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.
7. The values listed in the Range column are approximate. The certified values and corresponding Measurement Uncertainty (MU) will be reported at the time of calibration.
8. The resolution of the device under test (DUT) will be added to the Measurement Uncertainty (MU) at the time of calibration, which is stated as $0.6R$ (where R = resolution).
9. The Legal Entity for this facility is Transcat, Inc.
10. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2489.08.



Jason Stine, Vice President