



CERTIFICATE OF ACCREDITATION

ANSI National Accreditation Board

11617 Coldwater Road, Fort Wayne, IN 46845 USA

This is to certify that

Transcat - Charlotte

**8334 Arrowridge Blvd., Suite B
Charlotte, NC 28273**

has been assessed by ANAB and meets the requirements of international standard

ISO/IEC 17025:2017

and national standard

ANSI/NCSL Z540-1-1994 (R2002)

while demonstrating technical competence in the field of

CALIBRATION

Refer to the accompanying Scope of Accreditation for information regarding the types of activities to which this accreditation applies

AC-2489.07

Certificate Number


ANAB Approval

Certificate Valid Through: 09/07/2021
Version No. 004 Issued: 05/01/2019



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).



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SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017 AND ANSI/NCSL Z540-1-1994 (R2002)

Transcat – Charlotte
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CALIBRATION

Valid to: **September 7, 2021**

Certificate Number: **AC-2489.07**

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
AC Current – Measuring Equipment ¹	0 μ A to 220 μ A		Fluke 5700A-EP
	10 Hz to 20 Hz	0.028 % + 16 nA	
	20 Hz to 40 Hz	0.019 % + 10 nA	
	40 Hz to 1 kHz	0.014 % + 8.0 nA	
	1 kHz to 5 kHz	0.030 % + 12 nA	
	5 kHz to 10 kHz	0.11 % + 65 nA	
	0.22 mA to 2.2 mA		
	10 Hz to 20 Hz	0.027 % + 40 nA	
	20 Hz to 40 Hz	0.017 % + 35 nA	
	40 Hz to 1 kHz	0.014 % + 35 nA	
	1 kHz to 5 kHz	0.021 % + 110 nA	
	5 kHz to 10 kHz	0.11 % + 650 nA	
	2.2 mA to 22 mA		
	10 Hz to 20 Hz	0.028 % + 400 nA	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
AC Current – Measuring Equipment ¹	20 Hz to 40 Hz	0.018 % + 350 nA	Fluke 5700A-EP
	40 Hz to 1 kHz	0.014 % + 350 nA	
	1 kHz to 5 kHz	0.021 % + 550 nA	
	5 kHz to 10 kHz	0.11 % + 5 μ A	
	22 mA to 220 mA		
	10 Hz to 20 Hz	0.028 % + 4 μ A	
	20 Hz to 40 Hz	0.018 % + 3.5 μ A	
	40 Hz to 1 kHz	0.014 % + 2.5 μ A	
	1 kHz to 5 kHz	0.022 % + 3.5 μ A	
	5 kHz to 10 kHz	0.11 % + 10 μ A	
	0.22 A to 2.2 A		Fluke 5700A-EP with 5725A
	20 Hz to 1 kHz	0.027 % + 35 μ A	
	1 kHz to 5 kHz	0.047 % + 80 μ A	
	5 kHz to 10 kHz	0.71 % + 160 μ A	
	2.2 A to 11 A		Fluke 5700A-EP with 5725A
	20 Hz to 1 kHz	0.027 % + 170 μ A	
	1 kHz to 5 kHz	0.098 % + 380 μ A	
	5 kHz to 10 kHz	0.37 % + 750 μ A	Fluke 5520A
	11 A to 20.5 A		
	45 Hz to 100 Hz	0.095 % + 3.9 mA	
	100 Hz to 1 kHz	0.12 % + 3.9 mA	
	1 kHz to 5 kHz	2.3% + 3.9 mA	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
AC Current – Measuring Equipment ¹	20 A to 100 A 0.05 kHz to 1 kHz	0.12% + 300 μ A	Fluke 5520A Ballantine 1625A, Current Shunt, Agilent 3458A
Extended Frequency Ranges ¹	29 μ A to 330 μ A 10 kHz to 30 kHz	1.2 % + 0.31 μ A	Fluke 5520A
	330 μ A to 3.3 mA 10 kHz to 30 kHz	0.78 % + 0.47 μ A	
	3.3 mA to 33 mA 10 kHz to 30 kHz	0.31 % + 3.1 μ A	
	33 mA to 330 mA 10 kHz to 30 kHz	0.31 % + 0.16 mA	
Clamp-on Ammeter Toroidal Type ¹ Transformer Type	20 A to 150 A 45 Hz to 65 Hz	0.30 % + 26 mA	Fluke 5520A with 5500A/Coil
	20 A to 150 A 65 Hz to 440 Hz	0.83 % + 47 mA	
	150 A to 1000 A 45 Hz to 65 Hz	0.35 % + 0.12 A	
	150 A to 1000 A 65 Hz to 440 Hz	1.1 % + 0.22 A	
Clamp-on Ammeter Non-Toroidal Type ¹ Hall Effect Sensor	20 A to 150 A 45 Hz to 65 Hz	0.57 % + 0.25 A	Fluke 5520A with 5500A/Coil
	20 A to 150 A 65 Hz to 440 Hz	1 % + 0.25 A	



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Clamp-on Ammeter Non-Toroidal Type ¹ Hall Effect Sensor	150 A to 1000 A		Fluke 5520A with 5500A/Coil
	45 Hz to 65 Hz	0.60 % + 0.90 A	
	150 A to 1000 A		
	65 Hz to 440 Hz	1.3 % + 0.92 A	
AC Current – Measure ¹	0 μ A to 100 μ A		Agilent 3458A opt 002
	10 Hz to 20 Hz	0.46 % + 30 nA	
	20 Hz to 45 Hz	0.17 % + 30 nA	
	45 Hz to 100 Hz	0.072 % + 30 nA	
	100 Hz to 5 kHz	0.072 % + 30 nA	
	100 μ A to 1 mA		
	10 Hz to 20 Hz	0.46 % + 200 nA	
	20 Hz to 45 Hz	0.17 % + 200 nA	
	45 Hz to 100 Hz	0.071 % + 200 nA	
	100 Hz to 5 kHz	0.038 % + 200 nA	
	1 mA to 10 mA		
	10 Hz to 20 Hz	0.46 % + 2 μ A	
	20 Hz to 45 Hz	0.17 % + 2 μ A	
	45 Hz to 100 Hz	0.071 % + 2 μ A	
	100 Hz to 5 kHz	0.038 % + 2 μ A	
	10 mA to 100 mA		
	10 Hz to 20 Hz	0.46 % + 20 μ A	
	20 Hz to 45 Hz	0.17 % + 20 μ A	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
AC Current – Measure ¹	45 Hz to 100 Hz	0.071 % + 20 μ A	Agilent 3458A opt 002
	100 Hz to 5 kHz	0.037 % + 20 μ A	
	100 mA to 1 A		
	10 Hz to 20 Hz	0.46 % + 200 μ A	
	20 Hz to 45 Hz	0.19 % + 200 μ A	
	45 Hz to 100 Hz	0.097 % + 200 μ A	Ballantine 1625A with Agilent 3458A
	100 Hz to 5 kHz	0.12 % + 200 μ A	
	1 A to 2 A		
	50 Hz to 1 kHz	0.12 % + 200 μ A	
	2 A to 20 A		
DC Resistance – Measuring Equipment and Measure ¹	50 Hz to 1 kHz	0.12 % + 300 μ A	HP 3458A with Decade Resistor
	20 A to 100 A		
	50 Hz to 1 kHz	0.12% + 300 μ A	
	0 Ω to 10 Ω	18 $\mu\Omega/\Omega$ + 50 $\mu\Omega$	
	10 Ω to 100 Ω	15 $\mu\Omega/\Omega$ + 500 $\mu\Omega$	
	100 Ω to 1 k Ω	12 $\mu\Omega/\Omega$ + 500 $\mu\Omega$	
	1 k Ω to 10 k Ω	12 $\mu\Omega/\Omega$ + 5 m Ω	
	10 k Ω to 100 k Ω	12 $\mu\Omega/\Omega$ + 50 m Ω	
	100 k Ω to 1 M Ω	19 $\mu\Omega/\Omega$ + 2 Ω	
	1 M Ω to 10 M Ω	62 $\mu\Omega/\Omega$ + 100 Ω	
	10 M Ω to 100 M Ω	590 $\mu\Omega/\Omega$ + 1 k Ω	
	100 M Ω to 1 G Ω	0.58 % + 10 k Ω	



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
DC Resistance – Measuring Equipment ¹	100 $\mu\Omega$	810 $\mu\Omega/\Omega$	Fixed Resistors
	1 m Ω	500 $\mu\Omega/\Omega$	
	10 m Ω	200 $\mu\Omega/\Omega$	
	100 m Ω	86 $\mu\Omega/\Omega$	
	1 Ω	100 $\mu\Omega/\Omega$	
	10 M Ω to 100 M Ω	0.08 %	IET HRRS-B-7-100k-5kV
	100 M Ω to 1 G Ω	0.24 %	
	1 G Ω to 10 G Ω	0.42 %	
	10 G Ω to 100 G Ω	0.83 %	
	100 G Ω to 1 T Ω	2.4 %	
DC Current – Measuring Equipment and Measure ¹	0 μ A to 100 μ A	26 μ A/A + 0.8 nA	Agilent 3458A with Current Source
	100 μ A to 1 mA	26 μ A/A + 5 nA	
	1 mA to 10 mA	26 μ A/A + 50 nA	
	10 mA to 100 mA	41 μ A/A + 500 nA	
	100 mA to 1 A	130 μ A/A + 10 μ A	
DC Current – Measure ¹	1 A to 300 A	0.058 %	L&N 4363 shunt with DMM
DC Current – Measuring Equipment ¹	0.22 A to 2.2 A	92 μ A/A + 12 μ A	Fluke 5700A-EP With 5725A
	2.2 A to 11 A	280 μ A/A + 480 μ A	
	11 A to 20.5 A	780 μ A/A + 750 μ A	Fluke 5520A
Clamp-on Ammeter Non-Toroidal Type ¹	20 A to 150 A	0.50 % + 0.14 A	Fluke 5520A with 5500A/Coil
	150 A to 1000 A	0.51 % + 0.5 A	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
DC Voltage – Measure ¹	50 kV to 120 kV	0.083 %	High Voltage Divider
	0 V to 0.22 V 0.22 V to 2.2V	8.1 $\mu\text{V/V} + 0.4 \mu\text{V}$ 5.5 $\mu\text{V/V} + 0.7 \mu\text{V}$	Fluke 5700A-EP
DC Voltage – Measuring Equipment	2.2 V to 11 V	4.1 $\mu\text{V/V} + 2.5 \mu\text{V}$	
	11 V to 22 V	4.0 $\mu\text{V/V} + 4.0 \mu\text{V}$	
	22 V to 220 V	6.3 $\mu\text{V/V} + 40 \mu\text{V}$	
	220 V to 1100 V	7.7 $\mu\text{V/V} + 400 \mu\text{V}$	
DC Voltage – Measure ¹	0 V to 100 mV	7.1 $\mu\text{V/V} + 0.5 \mu\text{V}$	HP 3458A opt 002
	100 mV to 10 V	5.0 $\mu\text{V/V} + 0.5 \mu\text{V}$	
	10 V to 100 V	7.6 $\mu\text{V/V} + 30 \mu\text{V}$	
	100 V to 500 V	11 $\mu\text{V/V} + 100 \mu\text{V}$	
	500 V to 800 V	14 $\mu\text{V/V} + 100 \mu\text{V}$	
	800 V to 1000 V	21 $\mu\text{V/V} + 100 \mu\text{V}$	
	1 kV to 2 kV	0.051 % + 0.4 V	Vitretek 4600A with source
	2 kV to 20 kV	0.049 % + 4.0 V	
	20 kV to 50 kV	0.082 %	HV Divider with source
AC High Voltage – Measure ¹	700 V to 2 kV 20 Hz to 100 Hz	0.086 % + 2 V	Vitretek 4600A
	700 V to 2 kV 100 Hz to 400 Hz	0.53 % + 2 V	
	2 kV to 20 kV 20 Hz to 100 Hz	0.34 % + 20 V	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
AC High Voltage – Measure ¹	20 kV to 85 kV 60 Hz	0.48 %	HV Voltage Divider
AC Voltage – Measure ¹	0 mV to 10 mV		Agilent 3458A opt 002
	1 Hz to 40 Hz	0.035 % + 3 μV	
	40 Hz to 1 kHz	0.026 % + 1.1 μV	
	1 kHz to 20 kHz	0.034 % + 1.1 μV	
	20 kHz to 50 kHz	0.1 % + 1.1 μV	
	50 kHz to 100 kHz	0.51 % + 1.1 μV	
	100 kHz to 300 kHz	4 % + 2 μV	
	10 mV to 100 mV		
	1 Hz to 40 Hz	0.012 % + 4 μV	
	40 Hz to 1 kHz	0.008 5 % + 2 μV	
	1 kHz to 20 kHz	0.015 % + 2 μV	
	20 kHz to 50 kHz	0.03 % + 2 μV	
	50 kHz to 100 kHz	0.081 % + 2 μV	
	100 kHz to 300 kHz	0.31 % + 10 μV	
	300 kHz to 1 MHz	1 % + 10 μV	
	100 mV to 1 V		
	1 Hz to 40 Hz	0.008 9 % + 40 μV	
	40 Hz to 1 kHz	0.008 5 % + 20 μV	
	1 kHz to 20 kHz	0.015 % + 20 μV	
	20 kHz to 50 kHz	0.031 % + 20 μV	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
AC Voltage – Measure ¹	50 kHz to 100 kHz	0.081 % + 20 μ V	Agilent 3458A opt 002
	100 kHz to 300 kHz	0.30 % + 100 μ V	
	300 kHz to 1 MHz	1.0 % + 100 μ V	
	1 V to 10 V		
	1 Hz to 40 Hz	0.008 5 % + 0.4 mV	
	40 Hz to 1 kHz	0.008 6 % + 0.2 mV	
	1 kHz to 20 kHz	0.015 % + 0.2 mV	
	20 kHz to 50 kHz	0.031 % + 0.2 mV	
	50 kHz to 100 kHz	0.081 % + 0.2 mV	
	100 kHz to 300 kHz	0.3 % + 1 mV	
	300 kHz to 1 MHz	1.0 % + 1 mV	
	10 V to 100 V		
	1 Hz to 40 Hz	0.021 % + 4 mV	
	40 Hz to 1 kHz	0.021 % + 2 mV	
	1 kHz to 20 kHz	0.021 % + 2 mV	
	20 kHz to 50 kHz	0.036 % + 2 mV	
	50 kHz to 100 kHz	0.12 % + 2 mV	
	100 kHz to 300 kHz	0.40 % + 10 mV	
	300 kHz to 1 MHz	1.5 % + 10 mV	
	100 V to 700 V		
	1 Hz to 40 Hz	0.041 % + 40 mV	
	40 Hz to 1 kHz	0.041 % + 20 mV	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
AC Voltage – Measure ¹	1 kHz to 20 kHz	0.061 % + 20 mV	Agilent 3458A opt 002
	20 kHz to 50 kHz	0.12 % + 20 mV	
	50 kHz to 100 kHz	0.35 % + 20 mV	
AC Voltage – Measuring Equipment ¹	0 mV to 2.2 mV		
	10 Hz to 20 Hz	0.036 % + 4 μV	
	20 Hz to 40 Hz	0.033 % + 4 μV	
	40 Hz to 20 kHz	0.033 % + 4 μV	
	20 kHz to 50 kHz	0.033 % + 4 μV	
	50 kHz to 100 kHz	0.057 % + 5 μV	
	100 kHz to 300 kHz	0.13 % + 10 μV	
	300 kHz to 500 kHz	0.20 % + 20 μV	
	500 kHz to 1 MHz	0.31 % + 20 μV	
	2.2 mV to 22 mV		
	10 Hz to 20 Hz	0.044 % + 4 μV	
	20 Hz to 40 Hz	0.031 % + 4 μV	
	40 Hz to 20 kHz	0.015 % + 4 μV	
	20 kHz to 50 kHz	0.032 % + 4 μV	
	50 kHz to 100 kHz	0.060 % + 5 μV	
	100 kHz to 300 kHz	0.066 % + 10 μV	
	300 kHz to 500 kHz	0.17 % + 20 μV	
	500 kHz to 1 MHz	0.31 % + 20 μV	



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
AC Voltage – Measuring Equipment ¹	22 mV to 220 mV		Agilent 3458A opt 002
	10 Hz to 20 Hz	0.029 % + 12 µV	
	20 Hz to 40 Hz	0.011 % + 7 µV	
	40 Hz to 20 kHz	0.0087 % + 7 µV	
	20 kHz to 50 kHz	0.021 % + 7 µV	
	50 kHz to 100 kHz	0.048 % + 17 µV	
	100 kHz to 300 kHz	0.094 % + 20 µV	
	300 kHz to 500 kHz	0.15 % + 25 µV	
	500 kHz to 1 MHz	0.28 % + 45 µV	
	220 mV to 2.2 V		
	10 Hz to 20 Hz	0.028 % + 40 µV	
	20 Hz to 40 Hz	0.01 % + 15 µV	
	40 Hz to 20 kHz	0.004 9 % + 8 µV	
	20 kHz to 50 kHz	0.008 3 % + 10 µV	
	50 kHz to 100 kHz	0.012 % + 30 µV	
	100 kHz to 300 kHz	0.044 % + 80 µV	
	300 kHz to 500 kHz	0.01 % + 200 µV	
	500 kHz to 1 MHz	0.18 % + 300 µV	
	2.2 V to 22 V		
	10 Hz to 20 Hz	0.028 % + 0.4 mV	
	20 Hz to 40 Hz	0.01 % + 0.15 mV	
	40 Hz to 20 kHz	0.005 % + 50 µV	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
AC Voltage – Measuring Equipment ¹	20 kHz to 50 kHz	0.0084 % + 0.1 mV	Agilent 3458A opt 002
	50 kHz to 100 kHz	0.012 % + 0.2 mV	
	100 kHz to 300 kHz	0.031 % + 0.6 mV	
	300 kHz to 500 kHz	0.11 % + 2 mV	
	500 kHz to 1 MHz	0.17 % + 3.2 mV	
	22 V to 220 V		
	10 Hz to 20 Hz	0.028 % + 4 mV	
	20 Hz to 40 Hz	0.01 % + 1.5 mV	
	40 Hz to 20 kHz	0.005 7 % + 0.6 mV	
	20 kHz to 50 kHz	0.009 4 % + 1 mV	
	50 kHz to 100 kHz	0.017 % + 2.5 mV	
	100 kHz to 300 kHz	0.092 % + 16 mV	
	300 kHz to 500 kHz	0.45 % + 40 mV	
	500 kHz to 1 MHz	0.82 % + 80 mV	
	220 V to 1100 V		Fluke 5720A/5725A
	40 Hz to 1 kHz	0.011 % + 4 mV	
	1 kHz to 20 kHz	0.017 % + 6 mV	
	20 kHz to 30 kHz	0.061 % + 11 mV	
	220 V to 750 V		
	30 kHz to 50 kHz	0.062 % + 11 mV	
	50 kHz to 100 kHz	0.24 % + 45 mV	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Capacitance – Measure ¹	0 pF to 10 pF 60 Hz to 1 kHz	0.47 % + 0.014 pF	GenRad 1689M
	10 pF to 100 pF 60 Hz to 1 kHz	0.062 % + 0.014 pF	
	100 pF to 1 μF 60 Hz to 1 kHz	0.027 % + 0.014pF	
	1 μF to 100 μF 60 Hz to 1 kHz	0.035 % + 0.018pF	
	100 μF to 1000 μF 60 Hz to 1 kHz	0.24 % + 0.018pF	
Capacitance - Measuring Equipment ¹	0.1 nF to 0.5 nF 100 Hz to 1 kHz	0.65 pF	Arco SS32
	0.5 nF to 1400 nF 100 Hz to 1 kHz	0.13 pF	
	0.19 nF to < 1.1 nF 10 Hz to 10 kHz	0.39 % + 7.8 pF	5520A
	1.1 nF to < 3.3 nF 10 Hz to 3 kHz	0.39 % + 7.8 pF	
	3.3 nF to < 11 nF 10 Hz to 1 kHz	0.21 % + 7.8 pF	
	11 nF to < 110 nF 10 Hz to 1 kHz	0.21 % + 78 pF	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Capacitance - Measuring Equipment ¹	110 nF to < 330 nF 10 Hz to 1 kHz	0.21 % + 0.23 nF	5520A
	0.33 µF to < 1.1 µF 10 Hz to 600 Hz	0.21 % + 0.78 nF	
	1.1 µF to < 3.3 µF 10 Hz to 300 Hz	0.21 % + 2.3 nF	
	3.3 µF to < 11 µF 10 Hz to 150 Hz	0.21 % + 7.8 nF	
	11 µF to < 33 µF 10 Hz to 120 Hz	0.32 % + 23 nF	
	33 µF to < 110 µF 10 Hz to 80 Hz	0.36 % + 78 nF	
	110 µF to < 330 µF DC to 50 Hz	0.36 % + 0.23 µF	
	0.33 mF to < 1.1 mF DC to 20 Hz	0.36 % + 0.78 µF	
	1.1 mF to < 3.3 mF DC to 2 Hz	0.36 % + 2.3 µF	
	3.3 mF to < 11 mF DC to 6 Hz	0.36 % + 7.8 µF	
	11 mF to < 33 mF DC to 0.6 Hz	0.61 % + 23 µF	



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Capacitance - Measuring Equipment ¹	33 mF to < 110 mF DC to 0.2 Hz	0.90 % + 78 μ F	5520A
Inductance – Measure 60 Hz to 1 kHz	1 mH to 10 mH	0.034 % + 0.1 μ H	GenRad 1689M
	10 mH to 10 H	0.034 % + 1.4 μ H	
Inductance – Measuring Equipment ¹ 1 kHz	1 mH	0.12 %	Standard Inductor
	10 mH	0.12 %	
	100 mH	0.12 %	
Electrical Simulation of Thermocouple Devices ¹ Type B	250°C to 350°C	1.0°C	Ectron 1140A
	350°C to 445°C	0.77°C	
	445°C to 580°C	0.61°C	
	580°C to 750°C	0.47°C	
	750°C to 1000°C	0.39°C	
	1000°C to 1820°C	0.31°C	
Type E	-270°C to -245°C	2.1°C	
	-245°C to -195°C	0.20°C	
	-195°C to -155°C	0.11°C	
	-155°C to -90°C	0.09°C	
	-90°C to 0°C	0.08°C	
	0°C to 15°C	0.08°C	
	15°C to 890°C	0.07°C	
	890°C to 1000°C	0.08°C	
Type J	-210 °C to -180 °C	0.13 °C	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Electrical Simulation of Thermocouple Devices ¹ Type J	-180 °C to -120 °C	0.11 °C	Ectron 1140A
	-120 °C to -50 °C	0.09 °C	
	-50 °C to 990 °C	0.08 °C	
	990 °C to 1200 °C	0.08 °C	
Type K	-270°C to -255°C	2.3°C	
	-255 °C to -195 °C	0.73 °C	
	-195 °C to -115 °C	0.14 °C	
	-115 °C to -55 °C	0.10 °C	
	-55 °C to 1000 °C	0.08 °C	
	1000 °C to 1372 °C	0.09 °C	
Type N	-270°C to -260°C	5.1°C	
	-260°C to -200°C	1.1°C	
	-200°C to -140°C	0.25°C	
	-140 °C to -70 °C	0.16 °C	
	-70 °C to 25°C	0.13 °C	
	25°C to 160 °C	0.11 °C	
	160 °C to 1300 °C	0.10 °C	
Type R	-50°C to -30°C	0.68°C	
	-30°C to -45°C	0.58°C	
	-45°C to 160 °C	0.42 °C	
	160°C to 380 °C	0.31 °C	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Electrical Simulation of Thermocouple Devices ¹ Type R	380 °C to 775 °C	0.28 °C	Ectron 1140A
	775 °C to 1768 °C	0.23 °C	
Type S	-50°C to -30°C	0.65°C	
	-30°C to 45°C	0.59°C	
	45°C to 105 °C	0.42 °C	
	105°C to 310 °C	0.35 °C	
	310 °C to 615 °C	0.31 °C	
	615 °C to 1768 °C	0.27 °C	
Type T	-270°C to -255°C	1.8°C	
	-255°C to -240°C	0.51°C	
	-240°C to -210°C	0.32°C	
	-210 °C to -150 °C	0.19°C	
	-150 °C to -40 °C	0.13 °C	
	-40°C to 100 °C	0.09 °C	
	100 °C to 400 °C	0.08 °C	
Power Measuring Equipment DC Power 0.33 mA to 330 mA 0.33 A to 3 A 3 A to 20.5 A	11 µW to 1.1 mW	0.024 %	Fluke 5520A
	1.1 mW to 110 mW	0.027 %	
	0.11W to 110 W	0.024 %	
	110 W to 330 W	0.018 %	
	11 W to 110 mW	0.044 %	
	0.11 W to 990 W	0.053 %	
	1 W to 3 kW	0.009 6 %	
	0.099 W to 0.99 W	0.088 %	
	0.99 W to 6.8 kW	0.07 %	
	6.8 W to 20.5 kW	0.04 %	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
AC Power ^{1,3} (PF=1)			
10 Hz to 65 Hz			
3.3 mA to 9.0 mA	0.11 mW to 3.0 mW	0.13%	Fluke 5520A
	3.0 mW to 9.0 W	0.077%	
9.0 mA to 33 mA	0.3 mW to 10 mW	0.089 %	
	10 mW to 33W	0.077%	
33 mA to 90 mA	1 mW to 30 mW	0.071 %	
	30 mW to 90 W	0.057 %	
90 mA to 330 mA	3 mW to 100 mW	0.089 %	
	100 mW to 300 W	0.078 %	
0.33 A to 0.9 A	11 mW to 300 mW	0.071 %	
	300 mW to 900 W	0.081 %	
0.9 A to 2.2 A	30 mW to 720 mW	0.089 %	
	720 mW to 2 kW	0.079 %	
2.2 A to 4.5 A	80 mW to 1.4 W	0.088 %	
	1.4 W to 4.5 kW	0.18 %	
4.5 A to 20.5 A	150 mW to 6.7 W	0.17 %	
	6.7 W to 20 kW	0.17 %	



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Phase Meters Measure Equipment ¹	0° to 180°		Fluke 5520A
	10 Hz to 65 Hz	0.11°	
	65 Hz to 500 Hz	0.20°	
	500 Hz to 1 kHz	0.40°	
	1 kHz to 5 kHz	1.9°	
	5 kHz to 10 kHz	3.9°	
	10 kHz to 20 kHz	7.8°	
Sine Wave Flatness ¹ 50 Ω , 3 V Input	10 Hz to 1 MHz	0.052 %	Ballantine 1395B
	1 MHz to 10 MHz	0.095 %	
	10 MHz to 30 MHz	0.18 %	
	30 MHz to 50 MHz	0.41 %	
	50 MHz to 80 MHz	0.71 %	
	80 MHz to 100 MHz	0.84 %	
Oscilloscopes ¹			
Amplitude DC into 50 Ω Load into 1 M Ω Load	(-5.0 to 5.0) V (-200 to 200) V	0.023% + 19 μ V 0.023% + 19 μ V	Fluke 9500B
Amplitude Square Wave into 50 Ω Load Rate: 10 Hz to 10 kHz Rate: 10 Hz to 100 kHz	40 μ V _(pk-pk) to 1.0 mV _(pk-pk) 1.0 mV _(pk-pk) to 5.0 V _(pk-pk)	0.78% + 7.8 μ V 0.078% + 7.8 μ V	Fluke 9500B
into 1 M Ω Load Rate: 10 Hz to 10 kHz Rate: 10 Hz to 100 kHz	40 μ V _(pk-pk) to 1.0 mV _(pk-pk) 1.0 mV _(pk-pk) to 200 V _(pk-pk)	0.78% + 7.8 μ V 0.078% + 7.8 μ V	Fluke 9500B



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Timing - Generate ¹ 100 mV _(pk-pk) to 1.0 V _(pk-pk) Square Wave	9.009 1 ns to 83 μ s 83 μ s to 55 s	0.19 μ s/s 2.3 μ s/s	Fluke 9500
Sine Wave	450.5 ps to 9.009 ns	0.19 μ s/s	Fluke 9500
Pulse	900.91 ns to 83 μ s 83 μ s to 55 s	0.19 μ s/s 2.3 μ s/s	Fluke 9500
Triangle Wave	900.91 ns to 83 μ s 83 μ s to 55 s	0.19 μ s/s 2.3 μ s/s	Fluke 9500
Rise Time – Measure	800 ps to 1 μ s	930 ps	TDS 5054 Oscilloscope
Rise Time – Generate ^{1,6} 50 Ω Load 5.0 mV _(pk-pk) to 3.0 V _(pk-pk) Rate: 10 Hz to 2 MHz	500 ps (nominal) 150 ps (nominal)	290 ps 34 ps	Fluke 9500/ 9530
Leveled Sine Wave Generate ¹ 50 Ω Load Reference Frequency	50 kHz to 10 MHz	1.2 %	Fluke 9500/ 9530
Bandwidth/Flatness Measure ¹ Into VSWR (1.2:1) (wrt Reference Frequency) 5.0 mV _(pk-pk) to 5.0 V _(pk-pk) 5.0 mV _(pk-pk) to 3.0 V _(pk-pk) 5.0 mV _(pk-pk) to 2.0 V _(pk-pk)	0.10 Hz to 300 MHz 300 MHz to 550 MHz 550 MHz to 2.5 GHz 2.5 GHz to 3.2 GHz	1.6 % 1.9 % 2.7 % 3.1 %	Fluke 9500/ 9530
Input Impedance Measure ¹	10 Ω to 40 Ω 40 Ω to 90 Ω 90 Ω to 150 Ω 50 k Ω to 800 k Ω 800 k Ω to 1.2 M Ω 1.2 M Ω to 12 M Ω	0.39 % 0.083 % 0.39 % 0.39 % 0.083 % 0.39 %	Fluke 9500



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Input Capacitance Measure ¹	1.0 pF to 35 pF 35 pF to 95 pF	1.6 % + 0.19 pF 2.3 % + 0.19 pF	Fluke 9500/9530

Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
RF Power Measure 50 Ω , (1 μ W to 100 mW)	100 kHz to 4.2 GHz -30 dBm to +20 dBm	1.7 %	Agilent 437 with 8482A

Length – Dimensional Metrology

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ⁴	Reference Standard, Method and/or Equipment
Angles	0° to 75°	5.3"	Angle Blocks
	90°	1.2"	Master Square
Gage Blocks English	0.05 in to 1 in	(1.5 + 1.4L) μ in	Federal Comparator and Fed GGG-G15c Grade 1 Blocks
	1 in to 4 in	(0.7 + 1.9L) μ in	
Metric	1 mm to 10 mm	(0.028 + 4X) μ m	
	10 mm to 100 mm	(0.075 + 1.5X) μ m	
Micrometers and Calipers – Outside, Inside, Depth, Step ¹	0 in to 8 in	(20 + 5L) μ in	Comparison to Gage Blocks
	8 in to 48 in	(13 + 7L) μ in	
Anvil Flatness ¹	0 in to 3 in	6.7 μ in	Optical Flats



Length – Dimensional Metrology

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ⁴	Reference Standard, Method and/or Equipment
Length Measurement – Single Axis	0 in to 6 in	$(9 + 4L) \mu\text{in}$	Supermicrometer and Gage Blocks
	6 in to 10 in	$(2 + 5L) \mu\text{in}$	
Digital and Dial Indicators ¹	0 in to 6 in	$(4 + 7L) \mu\text{in}$	Comparison to Gage Blocks, or to Supermicrometer
Height Measuring Equipment ¹	0 in to 8 in	$(30 + 2L) \mu\text{in}$	Comparison to Gage Blocks
	8 in to 44 in	$(10 + 4L) \mu\text{in}$	
Height – Measure ¹	0 in to 8 in	$(37 + 2L) \mu\text{in}$	Comparison to Gage Blocks using Test Indicator and Electronic Amplifier
	8 in to 44 in	$(11 + 4L) \mu\text{in}$	
Parallelism & Straightness	0 in to 3 in	$(20 + 3.2L) \mu\text{in}$	Gage Amp & Surface Plate
	3 in to 24 in	$(30 + 3.2L) \mu\text{in}$	
2D Length - Measure	X Axis: 0 in to 9 in	290 μin	Optical Comparator
	Y Axis: 0 in to 4 in	290 μin	
Optical Comparator X Axis Y Axis X-Y Axis	0.05 in to 12 in	200 μin	Glass Grid
	0.05 in to 12 in	200 μin	
	0.05 in to 12 in	260 μin	Cylindrical Square
Outside Diameter – Plug/Pin Gages	0 in to 1 in	33 μin	Laser Micrometer and Master Pins/Plugs
Laser Micrometers	0 in to 1 in	$(13 + 3.2L) \mu\text{in}$	Master Pins
Tapes and Rulers ¹	(0 to 96) in	0.006 in + 14 $\mu\text{in/in}$	Glass Scale



Mass and Mass Related

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Force Measuring Equipment – Tension and Compression ¹	0 lbf to 500 lbf	0.025 % + 0.000 15 lbf	Dead Weight – NIST Class F Weights
Force Measuring Equipment – Tension and Compression ¹	50 lbf to 500 lbf	0.31 lbf	Interface Gold System
	500 lbf to 2 000 lbf	0.19 lbf	
	2 000 lbf to 5 000 lbf	2.3 lbf	
Force Measuring Equipment – Tension and Compression ¹	5 000 lbf to 10 000 lbf	1.5 lbf	Interface Gold System
	10 000 lbf to 25 000 lbf	4 lbf	
Mass - Metric	30 kg	33 mg	Echelon III
	25 kg	33 mg	
	20 kg	19 mg	
	10 kg	9.0 mg	
	5 kg	3.7 mg	
	2 kg	3.3 mg	
	1 kg	1.1 mg	
	500 g	0.37 mg	
	200 g	0.18 mg	
	100 g	0.23 mg	
	50 g	97 µg	
	20 g	70 µg	
	10 g	35 µg	
	5 g	21 µg	
	2 g	27 µg	
	1 g	29 µg	
	500 mg	17 µg	
	200 mg	17 µg	
	100 mg	16 µg	
	50 mg	16 µg	



Mass and Mass Related

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Mass - Metric	20 mg	16 µg	Echelon III
	10 mg	16 µg	
	5 mg	16 µg	
	2 mg	16 µg	
	1 mg	16 µg	
Mass - Avoirdupois	50 lb	110 µlb	Echelon III
	30 lb	100 µlb	
	20 lb	100 µlb	
	10 lb	18 µlb	
	5 lb	18 µlb	
	3 lb	16 µlb	
	2 lb	15 µlb	
	1 lb	15 µlb	
	8 oz	15 µlb	
	4 oz	5.1 µlb	
	2 oz	5.1 µlb	
	1 oz	5.1 µlb	
	0.5 oz	5.1 µlb	
Rockwell Hardness Measuring Equipment ¹	HRC High Middle Low	0.53 HRC 0.73 HRC 0.92 HRC	Hardness Blocks
Rockwell Hardness Measuring Equipment ¹	HRBw High Middle Low	1.2 HRBw 1.2 HRBw 1.3 HRBw	Hardness Blocks



Mass and Mass Related

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Durometer ¹	Type A, B, O	0.31 durometer units	Duro Calibrator ASTM D2240
	Type D, C, DO	0.16 durometer units	
Torque – Measure ¹	2.5 ozf·in to 1 000 lbf·ft	0.50 %	CDI 2000 Torque System
	1 000 lbf·ft to 2 000 lbf·ft	0.39 %	
Torque – Measuring Equipment ¹	2.5 ozf·in to 500 lbf·ft	0.055 %	Wheels/Arms & NIST Class F Weights
	500 lbf·in to 1 000 lbf·ft	0.074 %	
Balances & Scales ¹ Metric	30 kg 25 kg 20 kg 10 kg 5 kg 2 kg 1 kg 500 g 200 g 100 g 50 g 20 g 10 g 5 g 2 g 1 g 500 mg 200 mg 100 mg 50 mg 20 mg 10 mg	36 mg 33 mg 27 mg 7.2 mg 4.5 mg 6.3 mg 1.0 mg 0.35 mg 0.27 mg 0.38 mg 0.21 mg 163 µg 83 µg 42 µg 35 µg 21 µg 14 µg 14 µg 11 µg 11 µg 11 µg 11 µg	Characterized ASTM Class1 Mass Standards



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Mass and Mass Related

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Balances & Scales ¹	5 mg	11 µg	Characterized ASTM Class 1 Mass Standards
Metric	2 mg	11 µg	
	1 mg	11 µg	
Repeatability ⁷	1 mg to 90 kg	0.80 <i>D</i>	
Eccentricity ⁷	1 mg to 90 kg	0.80 <i>D</i>	
Avoirdupois	1 lb to 500 lb	0.013 %	NIST Class F Weights
Repeatability ⁷	1 lb to 500 lb	0.80 <i>D</i>	
Eccentricity ⁷	1 lb to 500 lb	0.80 <i>D</i>	
Absolute Pressure Source – Pneumatic	0.1 psia to 30 psia	0.002 4 psia	DHI PPC4 w/ RPM4 Indicator
	30 psia to 1 000 psia	0.006 7 % + 0.000 48 psia	
Gage Pressure Pneumatic ¹	-14.2 psig to 30 psig	0.002 psi	DHI PPC 4 Controller
	30 psi to 1 000 psi	0.006 7 % + 0.000 1 psi	
	-36 inH ₂ O to -22 inH ₂ O	0.009 % + 150 µinH ₂ O	
	-22 inH ₂ O to 22 inH ₂ O	0.002 2 inH ₂ O	
	22 inH ₂ O to 60 inH ₂ O	0.009 5 % + 150 µinH ₂ O	
Gage Pressure Pneumatic ¹	60 inH ₂ O to 72 inH ₂ O	0.006 6 inH ₂ O	DHI PPC 4 Controller
	72 inH ₂ O to 804 inH ₂ O	0.009 5 % + 150 µinH ₂ O	
	0.14 inH ₂ O to 0.36 inH ₂ O	0.058 % + 44 µpsi	Ametek RK-1100 WC
Gage Pressure, Hydraulic ¹	10 psig to 16 000 psig	0.012 %	Pressurements P3125-3



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Thermodynamic

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Relative Humidity Generate (-10°C to 15°C) (15°C to 35°C) (35°C to 70°C)	(10 to 75) %RH (75 to 95) %RH (10 to 95) %RH (10 to 50) %RH (50 to 75) %RH (75 to 95) %RH	0.50 % RH 0.65 % RH 0.50 % RH 0.50 % RH 0.70 % RH 0.85 % RH	Humidity Generator
Relative Humidity – Measure ¹ (10°C to 30°C)	20 % RH to 80 % RH	1.3 % RH	Vaisala HMI41/HMP46
Temperature Measuring Equipment	-80 °C to 100 °C	0.022 °C	Liquid Bath/Hart 5628
	100 °C to 200 °C	0.023 °C	
	200 °C to 300 °C	0.070 °C	Dry Block/Hart 5628
	300 °C to 600 °C	0.085 °C	
Temperature Measure ¹	-195 °C to 0 °C	0.012 °C + 0.001 %	Hart 5628
	0 °C to 420 °C	0.026 °C + 0.001 %	
	420°C to 600 °C	0.036 °C + 0.001 %	
Infrared Temperature Measuring Equipment $\epsilon = (0.1 \text{ to } 1.0)$ $\lambda = (8 \text{ to } 14) \mu\text{m}$	-15 °C to 0 °C	0.80 °C	Black Body Source
	0 °C to 50 °C	0.65 °C	
	50 °C to 100 °C	0.70 °C	
	100 °C to 120 °C	0.76 °C	
	120 °C to 200 °C	0.95 °C	
	200 °C to 350 °C	1.6 °C	
	350 °C to 500 °C	2.1 °C	



Time and Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Frequency – Source and Measure In-Lab	10 MHz	5.9×10^{-10}	Rubidium Oscillator
Field ¹	10 MHz	2.9×10^{-9}	HP 5328A Counter
Time – Measure	Up to 599 sec/month	0.058 sec/day	Vibrograf 4500
Total Harmonic Distortion 5 Hz to 600 kHz Fundamental Input Voltage Range < 30 V 100 % to 0.3 % 0.1 %	10 Hz to 1 MHz 1 MHz to 3 MHz 10 Hz to 20 Hz 20 Hz to 30 Hz 30 Hz to 300 kHz 300 kHz to 600 kHz	3.5 % 6.9 % 14 % 6.9 % 3.5 % 6.9 %	Agilent 334A
Input Voltage Range > 30 V 100 % to 0.3 %	500 kHz to 1.2 MHz 10 Hz to 300 kHz 300 kHz to 500 kHz 500 kHz to 3 MHz	14 % 3.5 % 6.9 % 14 %	
Input Voltage Range > 30 V 0.1 %	10 Hz to 20 Hz 20 Hz to 30 Hz 30 Hz to 300 kHz 300 kHz to 600 kHz 500 kHz to 1.2 MHz	14 % 6.9 % 3.5 % 6.9 % 14 %	Agilent 334A
Total Harmonic Distortion	0 dBm to -110 dBm 100 Hz to 1.5 GHz	1.8 dB	Rigol DSA815



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Acoustics and Vibration

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

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. Values listed with percent (%) are percent of reading or generated value unless otherwise noted.
3. The uncertainties shown are for the most favorable conditions. There is an increase in uncertainty that corresponds to the laboratory's AC voltage and current uncertainties at different frequencies other than the ones shown. Power factors (PF) other than the one shown contribute to the power uncertainty. PF is related to the cosine of phase. Therefore, uncertainties track the laboratory's phase uncertainty closely at PF near one, but are magnified heavily as PF approaches zero. The lab may also report reactive power, apparent power, and power factor under this accreditation. If needed, contact laboratory for more information regarding uncertainties at frequency and power factor combinations other than the ones shown.
4. L = Length in inches; X = Length in millimeters.
5. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2489.07.
6. The stated uncertainty is the laboratory's ability to source a fast rise pulse that is approximately 500 ps or 150 ps. In the typical application of measuring rise time of an oscilloscope, this value is one of the contributing factors, but other factors are derived from the DUT.
7. D is based upon "Readability" of scale or balance



Vice President