



# CERTIFICATE OF ACCREDITATION

## The ANSI National Accreditation Board

Hereby attests that

**Rothe Development, Inc. Metrology Services Division**  
1100 Hercules Ave., Suite 230  
Houston, TX 77058

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](http://www.anab.org).

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 11 March 2025  
Certificate Number: AC-1440



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)**

**Rothe Development, Inc. Metrology Services Division**

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**CALIBRATION**

Valid to: **March 11, 2025**

Certificate Number: **AC-1440**

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Source <sup>1</sup>	Up to 330 mV 330 mV to 3.3 V (3.3 to 33) V (33 to 330) V 330 V to 1 kV	16 $\mu$ V/V + 1.2 $\mu$ V 8.5 $\mu$ V/V + 2.3 $\mu$ V 9.3 $\mu$ V/V + 23 $\mu$ V 14 $\mu$ V/V + 0.18 mV 14 $\mu$ V/V + 1.8 mV	Fluke 5520A SC1100 Multifunction Calibrator
DC Voltage – Measure <sup>1</sup>	(10 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V 100V to 1 kV	13 $\mu$ V/V + 0.36 $\mu$ V 12 $\mu$ V/V + 0.68 $\mu$ V 12 $\mu$ V/V + 5.8 $\mu$ V 14 $\mu$ V/V + 68 $\mu$ V 14 $\mu$ V/V + 0.59 mV	HP 3458A Multimeter
	(1 to 15) kV	1.2 mV/V + 1.2 mV	Ross VD15 Divider with HP 3458A Multimeter
	Up to 150 kV	6.4 mV/V + 19 V	Ross VD150 Divider with HP 3458A Multimeter
DC Current – Source <sup>1</sup>	Up to 330 $\mu$ A 330 $\mu$ A to 3.3 mA (3.3 to 33) mA (33 to 330) mA 330 mA to 1.1A (1.1 to 3) A (3 to 11) A (11 to 20.5) A	0.13 mA/A + 23 nA 90 $\mu$ A/A + 58 nA 86 $\mu$ A/A + 0.29 $\mu$ A 89 $\mu$ A/A + 2.9 $\mu$ A 0.22 mA/A + 74 $\mu$ A 0.34 mA/A + 74 $\mu$ A 0.46 mA/A + 0.58 mA 0.8 mA/A + 0.87 mA	Fluke 5520A SC1100 Multifunction Calibrator



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Electrical – DC/Low Frequency

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	(25 to 120) A	4.7 mA + 85 $\mu$ A/A	52120A Transconductance Amplifier
DC Current – Source <sup>1</sup>	20 A to 1 kA	1.5 mA/A + 0.67 A	Fluke 5520A SC1100 Multifunction Calibrator with 5500A Coil
DC Current – Measure <sup>1</sup>	(10 to 100) nA 100 nA to 1 $\mu$ A (1 to 10) $\mu$ A (10 to 100) $\mu$ A 100 $\mu$ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	1.8 mA/A + 0.58 nA 0.17 mA/A + 0.58 nA 32 $\mu$ A/A + 0.59 nA 30 $\mu$ A/A + 1.1 nA 46 $\mu$ A/A + 82 nA 0.13 mA/A + 0.13 $\mu$ A 0.13 mA/A + 1.3 $\mu$ A 0.14 mA/A + 13 $\mu$ A	HP 3458A Multimeter
DC Current – Measure <sup>1</sup>	10 $\mu$ A 100 $\mu$ A 1 mA 10 mA 100 mA 1 A 10 A 30 A 100 A 200 A	1.2 nA 12 nA 0.12 $\mu$ A 1.2 $\mu$ A 11.7 $\mu$ A 0.12 mA 1.2 mA 3.5 mA 58 mA 0.12 A	HP 3458A Multimeter with Guildline Shunts
AC Voltage – Source <sup>1</sup>	Up to 33 mV (10 to 45) Hz 45 to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz (33 to 330) mV (10 to 45) Hz 45 to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.62 mV/V + 6.9 $\mu$ V 0.12 mV/V + 6.9 $\mu$ V 0.16 mV/V + 6.9 $\mu$ V 0.78 mV/V + 6.9 $\mu$ V 2.7 mV/V + 14 $\mu$ V 6.2 mV/V + 58 $\mu$ V  0.23mV/V + 9.2 $\mu$ V 0.11mV/V + 9.2 $\mu$ V 0.12mV/V + 9.2 $\mu$ V 0.27 mV/V + 9.2 $\mu$ V 0.62 mV/V + 37 $\mu$ V 1.6 mV/V + 81 $\mu$ V	Fluke 5520A SC1100 Multifunction Calibrator



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source <sup>1</sup>	330 mV to 3.3 V		Fluke 5520A SC1100 Multifunction Calibrator
	(10 to 45) Hz	0.23 mV/V + 58 μV	
	45 to 10 kHz	0.12 mV/V + 69 μV	
	(10 to 20) kHz	0.15 mV/V + 69 μV	
	(20 to 50) kHz	0.23 mV/V + 58 μV	
	(50 to 100) kHz	0.54 mV/V + 0.14 mV	
	(100 to 500) kHz	1.9 mV/V + 0.69 mV	
	(3.3 to 33) V		
	(10 to 45) Hz	0.23 mV/V + 0.75 mV	
	45 to 10 kHz	0.12 mV/V + 0.69 mV	
	(10 to 20) kHz	0.19 mV/V + 0.69 mV	
	(20 to 50) kHz	0.27 mV/V + 0.69 mV	
	(50 to 100) kHz	0.7 mV/V + 1.8 mV	
	(33 to 330) V		
	(10 to 45) Hz	0.15 mV/V + 2.3 mV	
	45 to 10 kHz	0.16 mV/V + 6.9 mV	
	(10 to 20) kHz	0.19 mV/V + 6.9 mV	
(20 to 50) kHz	0.23 mV/V + 6.9 mV		
(50 to 100) kHz	1.6 mV/V + 58 mV		
AC Voltage – Measure <sup>1</sup>	330 V to 1.02 kV		HP 3458A Multimeter
	45 Hz to 1 kHz	0.23 mV/V + 12 mV	
	(1 to 5) kHz	0.19 mV/V + 12 mV	
	(5 to 10) kHz	0.23 mV/V + 12 mV	
	(1 to 10) mV		
	(1 to 40) Hz	0.37 mV/V + 3.5 μV	
	40 Hz to 1 kHz	0.27 mV/V + 1.3 μV	
(1 to 20) kHz	0.36 mV/V + 1.3 μV		
(20 to 50) kHz	1.2 mV/V + 1.3 μV		
(50 to 100) kHz	5.8 mV/V + 1.3 μV		
(100 to 300) kHz	40 mV/V + 2.3 μV		
300 kHz to 1MHz	14 mV/V + 5.8 μV		
(1 to 4) MHz	81 mV/V + 1.2 μV		
(4 to 8) MHz	0.23 V/V + 9.2 μV		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure <sup>1</sup>	(10 to 100) mV		HP 3458A Multimeter
	(1 to 40) Hz	86 $\mu$ V/V + 4.7 $\mu$ V	
	40 Hz to 1 kHz	95 $\mu$ V/V + 2.4 $\mu$ V	
	(1 to 20) kHz	0.17 mV/V + 2.4 $\mu$ V	
	(20 to 50) kHz	0.35 mV/V + 2.4 $\mu$ V	
	(50 to 100) kHz	0.93 mV/V + 2.4 $\mu$ V	
	(100 to 300) kHz	3.5 mV/V + 12 $\mu$ V	
	300 kHz to 1 MHz	12 mV/V + 12 $\mu$ V	
	(1 to 2) MHz	17 mV/V + 12 $\mu$ V	
	(2 to 4) MHz	46 mV/V + 81 $\mu$ V	
	(4 to 8) MHz	46 mV/V + 92 $\mu$ V	
	(8 to 10) MHz	0.17 V/V + 0.1 mV	
	100 mV to 1 V		
	(1 to 40) Hz	86 $\mu$ V/V + 47 $\mu$ V	
	40 Hz to 1 kHz	91 $\mu$ V/V + 24 $\mu$ V	
	(1 to 20) kHz	0.17 mV/V + 24 $\mu$ V	
	(20 to 50) kHz	0.35 mV/V + 24 $\mu$ V	
	(50 to 100) kHz	0.93 mV/V + 24 $\mu$ V	
	(100 to 300) kHz	3.5 mV/V + 0.12 mV	
	300 kHz to 1 MHz	12 mV/V + 0.12mV	
	(1 to 2) MHz	17 mV/V + 0.12 mV	
	(2 to 4) MHz	46 mV/V + 0.81 mV	
	(4 to 8) MHz	46 mV/V + 0.92 mV	
	(8 to 10) MHz	0.17 V/V + 1.2 mV	
	(1 to 10) V		
	(1 to 40) Hz	0.11 mV/V + 0.47 mV	
	40 Hz to 1 kHz	0.11 mV/V + 0.24 mV	
	(1 to 20) kHz	0.18 mV/V + 0.24 mV	
(20 to 50) kHz	0.35 mV/V + 0.24 mV		
(50 to 100) kHz	0.93 mV/V + 0.24 mV		
(100 to 300) kHz	3.5 mV/V + 1.2 mV		
300 kHz to 1 MHz	12 mV/V + 1.2 mV		
(1 to 2) MHz	17 mV/V + 1.2 mV		
(2 to 4) MHz	46 mV/V + 8.1 mV		
(4 to 8) MHz	46 mV/V + 9.2 mV		
(8 to 10) MHz	0.17 V/V + 12 mV		

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure <sup>1</sup>	(10 to 100) V (1 to 40) Hz 40Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.23 mV /V + 4.7 mV 0.25 mV /V + 2.4 mV 0.25 mV /V + 2.4 mV 0.41 mV/V + 2.4 mV 1.4 mV/V + 2.4 mV 4.6 mV/V + 12 mV 0.2 V/V + 12 mV	HP 3458A Multimeter
	(100 to 700) V (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.46 mV V/V + 47 mV 0.46 mV /V + 24 mV 0.88 mV V + 24 mV 1.4 mV/V + 24 mV 3.5 mV/V + 24 mV	
	(1 to 15) kV @ 60 Hz	5.9 mV/V + 4.9 mV	
	Up to 100 kV @ 60 Hz	9.5 mV/V + 2.6 V	Ross VD150 Divider with HP 3458A Multimeter
AC Current – Source <sup>1</sup>	(29 to 330) $\mu$ A (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	1.6 mA/A + 0.12 $\mu$ A 1.2 mA/A + 0.12 $\mu$ A 1 mA/A + 0.12 $\mu$ A 2.3 mA/A + 0.17 $\mu$ A 6.2 mA/A + 0.23 $\mu$ A 12 mA/A + 0.46 $\mu$ A	Fluke 5520A SC1100 Multifunction Calibrator
	330 $\mu$ A to 3.3 mA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	1.6 mA/A + 0.17 $\mu$ A 1 mA/A + 0.17 $\mu$ A 0.78 mA/A + 0.17 $\mu$ A 1.6 mA/A + 0.23 $\mu$ A 3.9 mA/A + 0.35 $\mu$ A 7.8 mA/A + 0.69 $\mu$ A	
	(3.3 to 33) mA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	1.4 mA/A + 2.3 $\mu$ A 0.7 mA/A + 2.3 $\mu$ A 0.31 mA/A + 2.3 $\mu$ A 0.78 mA/A + 2.3 $\mu$ A 1.6 mA/A + 3.5 $\mu$ A 3.1 mA/A + 4.6 $\mu$ A	

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source <sup>1</sup>	(33 to 330) mA		Fluke 5520A SC1100 Multifunction Calibrator
	(10 to 20) Hz	1.4 mA/A + 23 μA	
	(20 to 45) Hz	0.7 mA/A + 23 μA	
	45 Hz to 1 kHz	0.31mA/A + 23 μA	
	(1 to 5) kHz	0.78 mA/A + 58 μA	
	(5 to 10) kHz	1.6 mA/A + 0.12 mA	
	(10 to 30) kHz	3.1 mA/A + 0.23 mA	
	330 mA to 1.1 A		
	(10 to 45) Hz	1.4 mA/A + 0.12 mA	
	45 Hz to 1 kHz	0.39 mA/A + 0.12 mA	
	(1 to 5) kHz	4.7 mA/A + 1.2 mA	
	(5 to 10) kHz	19 mA/A + 1.2 mA	
	(1.1 to 3) A		
	(10 to 45) Hz	1.4 mA/A + 0.12 mA	
45Hz to 1kHz	0.47 mA/A + 0.12 mA		
(1 to 5) kHz	4.7 mA/A + 1.2 mA		
(5 to 10) kHz	19 mA/A + 5.8 mA		
AC Current – Source <sup>1</sup>	(3 to 11) A		Fluke 5520A SC1100 Multifunction Calibrator With Fluke 9100-200 Coil
	(40 to 100) Hz	0.47 mA/A + 2.3 mA	
	100 Hz to 1kHz	0.78 mA/A + 5.8 mA	
	(1 to 5) kHz	23 mA/A + 5.8 mA	
AC Current – Source <sup>1</sup>	(11 to 20.5) A		52120A Transconductance Amplifier
	(40 to 100) Hz	0.93 mA/A + 2.3 mA	
	100 Hz to 1 kHz	1.2 mA/A + 5.8 mA	
AC Current – Source <sup>1</sup>	(20 to 200) A		Fluke 5520A SC1100 Multifunction Calibrator With 5500 Coil
	60 Hz	6.56 mA/A	
	(25 to 120) A		
	60 Hz	13 mA/A + 19 mA	
	400 Hz	0.78 mA/A + 94 mA	
	(20 to 50) A		
	(45 to 65) Hz	3.3 mA/A + 30 mA	
	(65 to 440) Hz	8.4 mA/A + 32 mA	
	(50 to 150) A		
	(45 to 65) Hz	3.4 mA/A + 30 mA	
	(65 to 440) Hz	8.5 mA/A + 32 mA	
	(150 to 500) A		
(45 to 65) Hz	3.4 mA/A + 0.19 A		
(65 to 440) Hz	8.9 mA/A + 0.2 A		



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Electrical – DC/Low Frequency

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AC Current – Source <sup>1</sup>	(500 to 1 000) A (45 to 65) Hz (65 to 440) Hz	4 mA/A + 0.28 A 9.4 mA/A + 0.35 A	Fluke 5520A SC1100 Multifunction Calibrator With 5500 Coil
AC Current – Source <sup>1</sup>	(500 to 3 000) A 60 Hz 400 Hz	7.3 mA/A + 0.56 mA 7.3 mA/A + 0.5 mA	52120A Transconductance Amplifier with 25 turn Coil
AC Current – Source <sup>1</sup>	(3 000 to 6 000) A 60 Hz 400 Hz	7.5 mA/A + 780 mA 7.5 mA/A + 780 mA	52120A Transconductance Amplifier with 50 turn Coil
AC Current – Measure <sup>1</sup>	(5 to 100) $\mu$ A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz 100 $\mu$ A to 1 mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz (1 to 10) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz (10 to 100) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	4.6 mA/A + 35 nA 1.7 mA/A + 35 nA 1.2 mA/A + 35 nA 1.2 mA/A + 35 nA 0.7 mA + 35 nA 4.6 mA/A + 0.24 $\mu$ A 1.9 mA/A + 0.24 $\mu$ A 1.9 mA/A + 0.24 $\mu$ A 0.36 mA/A + 0.24 $\mu$ A 0.7 mA/A + 0.24 $\mu$ A 4.6 mA/A + 0.47 $\mu$ A 6.4 mA/A + 1.7 $\mu$ A 4.6 mA/A + 2.4 $\mu$ A 1.7 mA/A + 2.4 $\mu$ A 0.7 mA/A + 2.4 $\mu$ A 0.35 mA/A + 2.4 $\mu$ A 0.70 mA/A + 2.3 $\mu$ A 4.6 mA/A + 4.6 $\mu$ A 6.4 mA/A + 17 $\mu$ A 4.6 mA/A + 23 $\mu$ A 1.7 mA/A + 23 $\mu$ A 0.7 mA/A + 23 $\mu$ A 0.36 mA/A + 23 $\mu$ A 1.1 mA/A + 23 $\mu$ A 4.7 mA/A + 46 $\mu$ A 6.4 mA/A + 0.17 mA	HP 3458A Multimeter





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AC Current – Measure <sup>1</sup>	100 mA to 1 A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz	4.6 mA/A + 0.23 mA 1.8 mA/A + 0.23 mA 0.93 mA/A + 0.23 mA 1.2 mA/A + 0.23 mA 3.5 mA/A + 0.23 mA 10 mA/A + 0.4 mA	HP 3458A Multimeter
AC Current – Measure <sup>1</sup>	(1 to 10) A 60 Hz to 400 Hz	2.5 mA/A + 1.2 mA	Keysight 34461A Multimeter
Resistance – Source <sup>1</sup>	Up to 11 Ω (11 to 33) Ω (33 to 111) Ω (110 to 330) Ω 330 Ω to 1.1k Ω (1.1 to 3.3) kΩ (3.3 to 11) kΩ (11 to 33) kΩ (33 to 110) kΩ (110 to 330) kΩ 330 kΩ to 1.19 MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ 330 MΩ to 1.1 GΩ	0.12 mΩ/Ω + 1.2 mΩ 0.12 mΩ/Ω + 1.7 mΩ 27 μΩ/Ω + 1.6 mΩ 24 μΩ/Ω + 2.3 mΩ 25 μΩ/Ω + 2.3 mΩ 26 μΩ/Ω + 2.3 mΩ 25 μΩ/Ω + 2.3 mΩ 23 μΩ/Ω + 0.23 Ω 23 μΩ/Ω + 0.23 Ω 26 μΩ/Ω + 2.3 Ω 35 μΩ/Ω + 2.3 Ω 48 μΩ/Ω + 35 Ω 0.12 mΩ/Ω + 58 Ω 0.28 mΩ/Ω + 2.9 kΩ 0.47 mΩ/Ω + 3.5 kΩ 2.3 mΩ/Ω + 0.12 MΩ 12 mΩ/Ω + 0.5 MΩ	Fluke 5520A SC1100 Multifunction Calibrator
Resistance Source	0.333 mΩ 0.001 Ω 0.010 Ω 0.10 Ω 1.0 Ω 10.0 Ω 100.0 Ω 1 000 Ω 10 000 Ω	0.11 mΩ 84 uΩ 71 uΩ 78 uΩ 0.23 mΩ 0.23 mΩ 2 mΩ 0.75 mΩ 0.14 Ω	Guildline 9711



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Resistance – Measure <sup>1</sup>	Up to 10 Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1 GΩ	23 μΩ/Ω + 86 μΩ 17 μΩ/Ω + 0.64 mΩ 15 μΩ/Ω + 0.86 mΩ 15 μΩ/Ω + 8.6 μΩ 15 μΩ/Ω + 86 μΩ 21 μΩ/Ω + 2.4 Ω 61 μΩ/Ω + 0.12 kΩ 0.58 mΩ/Ω + 3.5 kΩ 5.8 mΩ/Ω + 0.33 MΩ	HP 3458A Multimeter
Electrical Simulation of Thermocouple Indicators - Source and Measure <sup>1</sup>	Type B (600 to 800) °C (800 to 1 000) °C (1 000 to 1 550) °C (1 550 to 1 820) °C Type C (0 to 150) °C (150 to 650) °C (650 to 1 000) °C (1 000 to 1 800) °C (1 800 to 2 316) °C Type E (-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1 000) °C Type B (600 to 800) °C (800 to 1 000) °C (1 000 to 1 550) °C (1 550 to 1 820) °C Type C (0 to 150) °C (150 to 650) °C (650 to 1 000) °C (1 000 to 1 800) °C (1 800 to 2 316) °C	0.34 °C 0.26 °C 0.23 °C 0.26 °C 0.23 °C 0.2 °C 0.24 °C 0.39 °C 0.65 °C 0.39 °C 0.12 °C 0.11 °C 0.12 °C 0.16 °C 0.34 °C 0.26 °C 0.23 °C 0.26 °C 0.23 °C 0.2 °C 0.24 °C 0.39 °C 0.65 °C	Fluke 5520A SC1100 Multifunction Calibrator



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Electrical Simulation of Thermocouple Indicators - Source and Measure <sup>1</sup>	Type E		Fluke 5520A SC1100 Multifunction Calibrator
	(-250 to -100) °C	0.39 °C	
	(-100 to -25) °C	0.12 °C	
	(-25 to 350) °C	0.11 °C	
	(350 to 650) °C	0.12 °C	
	(650 to 1 000) °C	0.16 °C	
	Type J		
	(-210 to -100) °C	0.21 °C	
	(-100 to -30) °C	0.13 °C	
	(-30 to 150) °C	0.11 °C	
	(150 to 760) °C	0.13 °C	
	(760 to 1 200) °C	0.18 °C	
	Type K		
	(-200 to -100) °C	0.26 °C	
	(-100 to -25) °C	0.14 °C	
	(-25 to 120) °C	0.13 °C	
	(120 to 1 000) °C	0.2 °C	
	(1 000 to 1 372) °C	0.31 °C	
	Type L		
	(-200 to -100) °C	0.29 °C	
	(-100 to 800) °C	0.2 °C	
	(800 to 900) °C	0.13 °C	
	Type N		
	(-200 to -100) °C	0.31 °C	
(-100 to -25) °C	0.17 °C		
(-25 to 120) °C	0.15 °C		
(120 to 410) °C	0.14 °C		
(410 to 1 300) °C	0.21 °C		
Type R			
(0 to 250) °C	0.44 °C		
(250 to 400) °C	0.27 °C		
(400 to 1 000) °C	0.26 °C		
(1 000 to 1 767) °C	0.31 °C		
Type S			
(0 to 250) °C	0.47 °C		
(250 to 1 000) °C	0.36 °C		
(1 000 to 1 400) °C	0.37 °C		
(1 400 to 1 767) °C	0.46 °C		



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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicators - Source and Measure <sup>1</sup>	Type T (-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C Type U (-200 to 0) °C (0 to 600) °C	0.49 °C 0.19 °C 0.12 °C 0.11 °C 0.56 °C 0.27 °C	Fluke 5520A SC1100 Multifunction Calibrator
Electrical Simulation of RTD Indicating Devices <sup>1,2</sup>	Pt 385 (100 Ω) (-200 to 800) °C	(0.01 °C + 0.00021Y) °C	Fluke 5520A SC1100 Multifunction Calibrator
DC Power – Source <sup>1</sup> (1 to 1 000) V	1.5 W 6 W 12 W 20 W 30 W 60 W 120 W 500 W 1.5 kW 6 kW 30 kW 50 kW	0.06 % of Watts Output 0.05 % of Watts Output 0.07 % of Watts Output 0.06 % of Watts Output 0.1 % of Watts Output 0.08 % of Watts Output 0.05 % of Watts Output 0.07 % of Watts Output 0.07 % of Watts Output 0.1 % of Watts Output 0.09 % of Watts Output 0.09 % of Watts Output	Fluke 5520A SC1100 Multifunction Calibrator
AC Power – Source <sup>1</sup> (45 to 65) Hz P=1 (1 to 1 000) V	1.5 W 6 W 12 W 20 W 30 W 60 W 120 W 500 W 1500 W 6 kW 30 kW 50 kW	0.07 % of Watts Output 0.07 % of Watts Output 0.07 % of Watts Output 0.07 % of Watts Output 0.07 % of Watts Output 0.07 % of Watts Output 0.07 % of Watts Output 0.11 % of Watts Output 0.08 % of Watts Output 0.11 % of Watts Output 0.11 % of Watts Output 0.01 % of Watts Output	Fluke 5520A SC1100 Multifunction Calibrator
Capacitance – Source <sup>1</sup>	(4.7 to 470) nF 10Hz to 1kHz 1 μF to 1.1 mF (10 to 300) Hz	3.9 pF/nF + 42 pF 4.5 nF/uF + 2 nF	Fluke 5520A SC1100 Multifunction Calibrator

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Wave Generator – Source <sup>1</sup> Amplitude (10 Hz to 10 kHz) Square, Sine, Triangle into 1 MΩ Square, Sine, Triangle into 50 Ω Frequency	1.8 mV to 55 Vpp 1.8 mV to 2.5 Vpp 10 Hz to 100 kHz	30 mV/V + 0.1 mV 30 mV/V + 0.1 mV 25 parts in 10 <sup>6</sup> Hz + 15 mHz	Fluke 5520A SC1100 Multifunction Calibrator
Oscilloscopes <sup>1</sup> DC Signal into 50 Ω Load into 1 MΩ Load  Square Wave 50 Ω Load  1 MΩ Load	(-6.6 to 6.6) V (-130 to 130) V  1 mV to 6.6 V p-p 10 Hz to 10 kHz  1 mV to 130 V p-p 10 Hz to 10 kHz	2.9 mV/V + 47 μV 0.58 mV/V + 46 μV  2.9 mV/V + 48 μV  0.58 mV/V + 46 μV	Fluke 5520A SC1100 Multifunction Calibrator
Leveled Sine Wave - Flatness Relative to 50 kHz	5 mV to 5.5 V 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz 5mV to 3.5V (600 to 1 100) MHz	17 mV 23 mV 46 mV 58 mV	
Leveled Sine Wave – Frequency	50kHz to 1.1GHz	2.9 μHz/Hz + 4.2 mHz	
Leveled Sine Wave – Amplitude	5 mV to 5.5 Vpp	23 mV/V + 0.35 mV	
Time Marker <sup>2</sup> into 50 Ω Load-Source	5 s to 2 ns	5.8 ms/s + 0.1 μs	
Edge Specs into 50 Ω Load - Source Rise Time Amplitude Frequency	≤ 300 ps 5 mV to 2.5V 1 kHz to 10 MHz	120 ps 23 mV/V + 0.23 mV 2.9 μHz/Hz + 12 nHz	
Impedance Measurement	40 to 60 Ω 500 kΩ to 1.5 MΩ	1.2 mΩ/Ω + .92 mΩ 1.1mΩ/Ω + 18Ω	

**Length – Dimensional Metrology**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Micrometers, Outside <sup>1,2</sup>	(0 to 12) in (12 to 24) in	(580 + 0.21L) μin (570 + 0.72L) μin	Grade 2 Gage Blocks
Micrometers, Inside <sup>1,2</sup>	Up to 12 in (12 to 24) in	(570 + .17L) μin (180 + .71L) μin	
Micrometers, Depth <sup>1,2</sup>	(0 to 12) in	(580 + .18L) μin	
Calipers <sup>1,2</sup>	Up to 6 in (6 to 12) in (12 to 24) in	(290 + 0.22L) μin (280 + 1.1L) μin (280 + 1.4L) μin	Grade 2 Gage Blocks
Height Gages <sup>1,2</sup>	Up to 24 in	(170 + 3.7L) μin	Grade 2 Gage Blocks Grade A Surface Plate
Indicators <sup>2</sup>	Up to 1 in	(43 + 20L) μin	P&W Labmaster Universal 1000A
Plain Plug and Pin Gages	Up to 1 in	8.5 μin	P&W LMU 1000A Grade 00 Gage Blocks
Gage Blocks <sup>2</sup>	Up to 4 in (5 to 20) in	(3.7 + 0.97L) μin (4.7 + 2.8L) μin	P&W LMU 1000A Grade 00 Gage Blocks
Setting Standards <sup>2</sup>	Up to 40 in	(2.4 + 7.6L) μin	P&W Labmaster Universal 1000A Grade 00 Gage Blocks
Cylindrical Rings <sup>2</sup>	(0.25 to 4) in	(5.1 + 5.8L) μin	P&W Labmaster Universal 1000A, Class XXX Rings
Steel Tapes and Rules <sup>2</sup>	Up to 25 ft	(680 + 34L) μin	P&W Labmaster Universal 1000A, Grade 00 Gage Blocks
Granite Surface Plates Overall Flatness	Diagonal up to 5 ft	61 μin	Mahr Federal EMD-832P-48-W2 Electronic Levels
Local Area Flatness (Repeat Reading)	Up to 0.04 in	86 μin	Repeat-o-meter
Thread Plugs Pitch Diameter Major Diameter	Up to 5 in Up to 5 in	100 μin 51 μin	P&W Model C Supermicrometer, Grade 2 Gage Blocks, Thread Wires

**Mass and Mass Related**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Torque Wrenches <sup>1,2</sup>	5 to 50) lbf·in (40 to 400) lbf·in (100 to 1 000) lbf·in (25 to 250) lbf·ft	(0.4 + 0.023 <i>T</i> ) lbf·in (0.15 + 0.003 5 <i>T</i> ) lbf·in (0.47 + 0.002 7 <i>T</i> ) lbf·in (0.003 + 0.052 <i>T</i> ) lbf·ft	CDI 5000ST Torque System and 2000-400-02 Transducer Kit
Mass – Measure Fixed Points, Metric	0.5 g 1 g 2 g 5 g 10 g 20 g 50 g 100 g 200 g 500 g 700 g 1 kg 3 kg 5 kg 6 kg 10 kg 20 kg 30 kg	150 µg 190 µg 240 µg 330 µg 450 µg 650 µg 1 mg 1.9 mg 2.3 mg 12 mg 15 mg 20 mg 59 mg 95 mg 110 mg 230 mg 390 mg 570 mg	ASTM Class 1 Weights, NIST Class S-1 Weights, Precision Mass Comparators/ Balances
Mass – Precision Balances <sup>2</sup>	(0 to 2) g (2 to 20) g (20 to 200) g (200 to 1000) g (1 to 6) kg (0 to 30) kg	(350 + 240 <i>M</i> ) µg (140 + 350 <i>M</i> ) µg (20 + 360 <i>M</i> ) µg (310 + 15 <i>M</i> ) µg (17 + 0.014 <i>M</i> ) mg (160 + 0.016 <i>M</i> ) mg	ASTM Class 1 Weights, NIST Class S-1 Weights
Pressure Gauges, Transducers – Measure <sup>1,2</sup>	(3 to 30) psi (20 to 100) psi (100 to 500) psi (200 to 1 000) psi (1 000 to 5 000) psi (2 000 to 10 000) psi	(0.008 6 + 0.000 92 <i>P</i> ) psi (0.038 + 0.000 87 <i>P</i> ) psi (0.04 + 0.001 1 <i>P</i> ) psi (0.076 + 0.001 1 <i>P</i> ) psi (0.4 + 0.001 1 <i>P</i> ) psi (0.69 + 0.001 1 <i>P</i> ) psi	Digital Pressure Gauges Crystal 30PSIXP2I Crystal 100PSIXP2I Crystal 500PSIXP2I Crystal 1KPSIXP2I Crystal 5KPSIXP2I Crystal 10KPSIXP2I
	(-5 to 0) psi (0 to 3) psi (0 to 15) psi	0.000 6 psi 0.000 37 psi 0.001 8 psi	Mensor CPG 2500 with transducer CPT6100 transducer CPR2550-3 transducer CPR2550-15
	(4 000 to 20 000) psi (7 200 to 36 000) psi	(0.97 + 0.000 19 <i>P</i> ) psi (3.1 + 0.000 091 <i>P</i> ) psi	Additel 681-20KPSI Additel 681-36KPSI

**Mass and Mass Related**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pressure Gauges, Transducers – Measure <sup>1,2</sup>	(-5 to 0) inH <sub>2</sub> O (0 to -5) inH <sub>2</sub> O	0.005 9 inH <sub>2</sub> O 0.005 8 inH <sub>2</sub> O	Additel ADT681-05-DP5-H2O
Pressure Gauges, Transducers – Measure <sup>2</sup>	(-15 to 0) psi (0 to 30) psi (0 to 100) psi	(0.006 + 0.000 78 <i>P</i> ) psi (0.003 6 + 0.000 047 <i>P</i> ) psi (0.004 2 + 0.000 11 <i>P</i> ) psi	GE Druck Pace 1002 Pressure Indicator
	(100 to 1 500) psi (1 500 to 15 000) psi	(0.007 + 0.000 11 <i>P</i> ) psi (0.56 + 0.000 08 <i>P</i> ) psi	Mensor CPB5000 Pressure Balance
Absolute Pressure-Measure (Barometers)	(8 to 17) psi	0.001 3 psi	Mensor CPG2500 without additional transducer

**Thermodynamic**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature - Source	(-45 to 155) °C	0.07 °C	Ametek RTC 157B Temperature Calibrator, STS 200 B915 PRT
Temperature - Source	(-90 to 140) °C	0.24 °C	Fluke 9190A Dry Well Ultra-Cold Calibrator
Temperature - Source	(50 to 650) °C	(1.1 + 0.000 012 <i>Y</i> ) °C	Ametek CTC-650A Dry Block Calibrator
Temperature - Measure <sup>1</sup>	(-90 to 600) °C	(0.05 + 0.000 115 8 <i>Y</i> ) °C	Fluke 1524 Thermometer with Fluke 5628 PRT
	(15 to 30) °C	0.3 °C	Rotronic Hygropalm
Infrared (IR) Temperature – Source <sup>1</sup>	-15 °C 0 °C 50 °C 100 °C 120 °C	0.65 °C 0.6 °C 0.72 °C 0.82 °C 0.8 °C	Fluke 4180 IR Calibrator $\epsilon = 0.95, \lambda = (8 \text{ to } 14) \mu\text{m}$
	200 °C 350 °C 500 °C	1 °C 1.7 °C 2.2 °C	Fluke 4181 IR Calibrator $\epsilon = 0.95, \lambda = (8 \text{ to } 14) \mu\text{m}$
Humidity	LiCl, 11 %RH MgCl, 33 %RH NaCl, 75 %RH	1.2 %RH 1.2 %RH 1.4 %RH	Saturated Salt Solutions monitored with a reference Hygrometer
Humidity	(0 to 80) %RH	1.1 %RH	Rotronic Hygropalm Hygrometer




**Time and Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source <sup>1</sup>	0.01 Hz to 2 MHz	2 $\mu$ Hz/Hz + 8 $\mu$ Hz	Fluke 5520A SC1100 Multifunction Calibrator
	10 MHz	1 part in 10 <sup>-11</sup> Hz	Spectracom 8194 GPS Oscillator
Stopwatches /Timers <sup>1</sup>	Up to 24 hours	5.8 ms	Fluke 5520A SC1100 Multifunction Calibrator with Spectracom 8194 GPS Oscillator and Fluke PM6680B Counter
Non-Contact Tachometers <sup>1</sup>	(60 to 99 999) rpm	0.58 rpm	Fluke 5520A SC1100 Multifunction Calibrator with Spectracom 8194 GPS Oscillator Agilent 3325B Signal Generator

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,  $P$  = pressure in psi,  $p$  = pressure in inH<sub>2</sub>O,  $M$  = mass in grams,  $t$  = time in seconds,  $T$  = torque in applicable units of measurement,  $Y$  = temperature in degrees Celsius.
3. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-1440.



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