



THE AMERICAN ASSOCIATION FOR  
LABORATORY ACCREDITATION

## ACCREDITED LABORATORY

A2LA has accredited

**CALSOURCE**

**Syracuse, NY**

for technical competence in the field of

### Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and any additional program requirements in the field of calibration. 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 18 June 2005*).



Presented this 11<sup>th</sup> day of April 2008.

A handwritten signature in cursive script, reading "Peter Abney".

President  
For the Accreditation Council  
Certificate Number 2133.01  
Valid to February 28, 2010

For the calibrations to which this accreditation applies, please refer to the laboratory's Calibration Scope of Accreditation.

SCOPE OF ACCREDITATION TO ISO 17025:2005  
& ANSI/NCSL Z540-1-1994

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CALIBRATION

Valid To: February 28, 2010

Certificate Number: 2133.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations<sup>1</sup>:

I. Dimensional

Parameter/Equipment	Range	Best Uncertainty <sup>2,4</sup> ( $\pm$ )	Comments
Gage Blocks – Length	Up to 1 in (1 to 6) in	3.5 $\mu$ in (5 + 0.5L) $\mu$ in	P&W Labmaster & master gage blocks
Micrometers <sup>3</sup> – Inside, Outside, Depth	Up to 20 in	(0.6R + 10L) $\mu$ in	Gage blocks
Calipers <sup>3</sup> – Outside, Inside, Depth and End Face	Up to 48 in	(0.6R + 5L) $\mu$ in	Gage blocks
Dial Indicators <sup>3</sup>	(0.015 to 4) in	0.6R	P&W Model C Supermic

Parameter/Equipment	Range	Best Uncertainty <sup>2,4</sup> ( $\pm$ )	Comments
Height Gages <sup>3</sup>	(1 to 24) in	(65 + 1L) $\mu$ in	Gage blocks
Plug/Pin Gages	(0.005 to 10) in	(21 + 10D) $\mu$ in	P&W Universal Supermic, grade 1 gage blocks
Plain Rings	(0.25 to 9) in	(20 + 7D) $\mu$ in	P&W Universal Supermic, grade 1 gage blocks
Tape Measure (Steel)	(0 to 25) ft	0.037 in	Gage Blocks and reference ruler
Rulers <sup>3</sup>	To 12 in	(470 + 30L) $\mu$ in	Gage blocks

## II. Mechanical

Parameter/Equipment	Range	Best Uncertainty <sup>2</sup> ( $\pm$ )	Comments
Pressure, Nitrogen			
Gage/ABS	(0 to 100) psia/psig	36 parts in $10^6$	Ruska DWT
Negative Gage	(100 to 1000) psia/psig	53 parts in $10^6$	
Barometric	(-14.5 to 0) psig (10 to 16) psig	30 parts in $10^6$ 0.01 % of rdg	DHI RPM 4
Scales <sup>3</sup>	(1 to 500) mg (1 to 100) g (200 to 1000) g (1 to 10) kg	0.017 mg 0.18 mg 1.7 mg 17 mg	NIST Handbook 44 with Class F, Class 1 or 2 weights

Parameter/Equipment	Range	Best Uncertainty <sup>2</sup> (±)	Comments
Torque	(2 to 20) in·oz (15 to 200) in·oz (4 to 50) in·lb (30 to 400) in·lb (800 to 1000) in·lb (20 to 250) ft·lb (100 to 1000) ft·lb	0.063 in·oz 0.59 in·oz 0.15 in·lb 1.2 in·lb 3 in·lb 0.73 in·lb 2.9 ft·lb	CDI torque system

### III. Thermodynamics

Parameter/Equipment	Range	Best Uncertainty <sup>2</sup> (±)	Comments
Relative Humidity	10 % RH to 95 % RH	2.0 % RH	Rotronic RH transmitter, Fluke Hydra data logger
Thermometers – Measure and Measuring Equipment	(-197 to 420) °C	0.05 °C	Hart 1575, SPRT, Azonix A1011, and RTD

### IV. Time & Frequency

Parameter/Equipment	Range	Best Uncertainty <sup>2,5</sup> (±)	Comments
Frequency – Measuring Equipment	0.01 Hz to 2 MHz	2.5 µHz/Hz + 5 µHz	Fluke 5520A
Frequency – Measure	(1 to 40) Hz 40 Hz to 10 MHz	0.05 % 0.01 %	Agilent 3458A
Stop Watch	15 min to 24 hr	0.4 ms	Agilent 53131A

V. Electrical – DC & Low Frequency

Parameter/Equipment	Range	Best Uncertainty <sup>2,5</sup> ( $\pm$ )	Comments
DC Voltage <sup>3</sup> – Measure	Up to 200 mV 200 mV to 2V (2 to 20) V (20 to 200) V (200 to 1000) V	4.5 $\mu$ V/V + 0.1 $\mu$ V 3 $\mu$ V/V + 0.4 $\mu$ V 3 $\mu$ V/V + 4 $\mu$ V 4.5 $\mu$ V/V + 40 $\mu$ V 4.5 $\mu$ V/V + 0.5 mV	Fluke 8508A/01
	(10 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	11 $\mu$ V/V + 0.3 $\mu$ V 10 $\mu$ V/V + 0.3 $\mu$ V 10 $\mu$ V/V + 0.5 $\mu$ V 12 $\mu$ V/V + 30 $\mu$ V 22 $\mu$ V/V + 100 $\mu$ V	HP 3458A
DC Voltage <sup>3</sup> – Generate	Up to 220 mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V (100 to 1100) V	7.5 $\mu$ V/V + 0.4 $\mu$ V 5 $\mu$ V/V + 0.7 $\mu$ V 3.5 $\mu$ V/V + 2.5 $\mu$ V 3.5 $\mu$ V/V + 4 $\mu$ V 5 $\mu$ V/V + 40 $\mu$ V 6.5 $\mu$ V/V + 400 $\mu$ V	Fluke 5720A/03
	Up to 330 mV (0.33 to 3.3) V (3.3 to 33) V (33 to 330) V (330 to 1000) V	20 $\mu$ V/V + 1 $\mu$ V 11 $\mu$ V/V + 2 $\mu$ V 12 $\mu$ V/V + 20 $\mu$ V 18 $\mu$ V/V + 150 $\mu$ V 18 $\mu$ V/V + 1.5 mV	Fluke 5520A
Fixed Point	10 V	2 parts in 10 <sup>6</sup> (trend < 1 part in 10 <sup>6</sup> )	Fluke 7000 & 7000N
DC Current <sup>3</sup> – Measure	Up to 200 $\mu$ A 200 $\mu$ A to 2 mA (2 to 20) mA (20 to 200) mA 200 mA to 2.0 A (2 to 20) A	12 $\mu$ A/A + 0.4 nA 12 $\mu$ A/A + 4 nA 13 $\mu$ A/A + 40 nA 36 $\mu$ A/A + 0.8 $\mu$ A 0.017 % + 16 $\mu$ A 0.038 % + 400 $\mu$ A	Fluke 8508A/01
	(10 to 100) $\mu$ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	25 $\mu$ A/A + 0.8 nA 25 $\mu$ A/A + 5 nA 25 $\mu$ A/A + 50 nA 40 $\mu$ A/A + 0.5 $\mu$ A 0.012 % + 10 $\mu$ A	HP 3458A

Parameter/Equipment	Range	Best Uncertainty <sup>2,5</sup> ( $\pm$ )	Comments
DC Current <sup>3</sup> – Generate	Up to 220 $\mu$ A 220 $\mu$ A to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A  (2.2 to 11) A	40 $\mu$ A/A + 6 nA 35 $\mu$ A/A + 7 nA 35 $\mu$ A/A + 40 nA 45 $\mu$ A/A + 10 $\mu$ A 80 $\mu$ A/A + 49 $\mu$ A  0.036 % + 480 nA	Fluke 5720A    w/ 5725A
Resistance <sup>3</sup> – Measure	Up to 2 $\Omega$ (2 to 20) $\Omega$ (20 to 200) $\Omega$  200 $\Omega$ to 2 k $\Omega$ (2 to 20) k $\Omega$ (20 to 200) k $\Omega$ 200 k $\Omega$ to 2 M $\Omega$ (2 to 20) M $\Omega$ (20 to 200) M $\Omega$ 200 M $\Omega$ to 2 G $\Omega$  (1 to 10) k $\Omega$	15 $\mu\Omega/\Omega$ + 4 $\mu\Omega$ 9 $\mu\Omega/\Omega$ + 14 $\mu\Omega$ 7.5 $\mu\Omega/\Omega$ + 50 $\mu\Omega$  7.5 $\mu\Omega/\Omega$ + 0.5 m $\Omega$ 7.5 $\mu\Omega/\Omega$ + 5 m $\Omega$ 7.5 $\mu\Omega/\Omega$ + 50 m $\Omega$ 8.5 $\mu\Omega/\Omega$ + 1 $\Omega$ 15 $\mu\Omega/\Omega$ + 100 $\Omega$ 60 $\mu\Omega/\Omega$ + 10 k $\Omega$ 0.053 % + 1 M $\Omega$  1 part in 10 <sup>6</sup>	Fluke 8508A         Thomas 1 $\Omega$ and Guildline 9975

Parameter/Equipment	Range	Best Uncertainty <sup>2,5</sup> ( $\pm$ )	Comments
Resistance <sup>3</sup> – Generate	Up to 11 $\Omega$ (11 to 33) $\Omega$ (33 to 110) $\Omega$ (110 to 330) $\Omega$ 330 $\Omega$ to 1.1 k $\Omega$ (1.1 to 3.3) k $\Omega$ (3.3 to 11) k $\Omega$ (11 to 33) k $\Omega$ (33 to 110) k $\Omega$ (110 to 330) k $\Omega$ 330 k $\Omega$ to 1.1 M $\Omega$ (1.1 to 3.3) M $\Omega$ (3.3 to 11) M $\Omega$ (11 to 33) M $\Omega$ (33 to 110) M $\Omega$ (110 to 330) M $\Omega$ 330 M $\Omega$ to 1.1 G $\Omega$	40 $\mu\Omega/\Omega$ 30 $\mu\Omega/\Omega$ 28 $\mu\Omega/\Omega$ 28 $\mu\Omega/\Omega$ 28 $\mu\Omega/\Omega$ 28 $\mu\Omega/\Omega$ 28 $\mu\Omega/\Omega$ 28 $\mu\Omega/\Omega$ 28 $\mu\Omega/\Omega$ 28 $\mu\Omega/\Omega$ 32 $\mu\Omega/\Omega$ 32 $\mu\Omega/\Omega$ 60 $\mu\Omega/\Omega$ 0.013 % 0.025 % 0.05 % 0.3 % 1.5 %	Fluke 5520A

Parameter/Equipment	Range	Best Uncertainty <sup>2,5</sup> ( $\pm$ )	Comments
Resistance <sup>3</sup> – Generate			
Fixed Points	1 $\Omega$ 1.9 $\Omega$ 10 $\Omega$ 19 $\Omega$ 100 $\Omega$ 190 $\Omega$ 1 k $\Omega$ 1.9 k $\Omega$ 10 k $\Omega$ 19 k $\Omega$ 100 k $\Omega$ 190 k $\Omega$ 1 M $\Omega$ 1.9 M $\Omega$ 10 M $\Omega$ 19 M $\Omega$ 100 M $\Omega$	95 $\mu\Omega/\Omega$ 95 $\mu\Omega/\Omega$ 23 $\mu\Omega/\Omega$ 23 $\mu\Omega/\Omega$ 23 $\mu\Omega/\Omega$ 10 $\mu\Omega/\Omega$ 10 $\mu\Omega/\Omega$ 8.5 $\mu\Omega/\Omega$ 8.5 $\mu\Omega/\Omega$ 8.5 $\mu\Omega/\Omega$ 8.5 $\mu\Omega/\Omega$ 11 $\mu\Omega/\Omega$ 11 $\mu\Omega/\Omega$ 20 $\mu\Omega/\Omega$ 21 $\mu\Omega/\Omega$ 40 $\mu\Omega/\Omega$ 47 $\mu\Omega/\Omega$	Fluke 5720A
	10 $\Omega$	0.35 part in 10 <sup>6</sup>	Thomas 1 $\Omega$

Parameter/Range	Frequency	Best Uncertainty <sup>2,5</sup> ( $\pm$ )	Comments
AC Current <sup>3</sup> – Generate			
Up to 220 $\mu$ A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.025 % + 16 nA 0.016 % + 10 nA 0.012 % + 8 nA 0.028 % + 12 nA 0.11 % + 65 nA	Fluke 5720A
(0.22 to 2.2) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.25 % + 40 nA 0.16 % + 35 nA 0.12 % + 35 nA 0.02 % + 110 nA 0.11 % + 650 nA	
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.025 % + 400 nA 0.016 % + 350 nA 0.012 % + 350 nA 0.02 % + 550 nA 0.11 % + 5 $\mu$ A	

Parameter/Range	Frequency	Best Uncertainty <sup>2,5</sup> (±)	Comments
AC Current <sup>3</sup> (cont.) – Generate			
(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	0.025 % + 4 µA 0.016 % + 3.5 µA 0.012 % + 2.5 µA 0.02 % + 3.5 µA 0.11 % + 10 µA	Fluke 5720A
(220 to 2.2) A	(20 to 1000) Hz (1 to 5) kHz (5 to 10) kHz	0.026 % + 35 µA 0.045 % + 80 µA 0.7 % + 160 µA	w/ 5725A
(2.2 to 11) A	(40 to 1000) Hz (1 to 5) kHz (5 to 10) kHz	0.046 % + 170 µA 0.095 % + 380 µA 0.36 % + 750 µA	Fluke 5720A w/5725A
(29 to 330) µA	(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	0.2 % + 0.1 µA 0.15 % + 0.1 µA 0.13 % + 0.1 µA 0.3 % + 0.15 µA 0.8 % + 0.2 µA 1.6 % + 0.4 µA	
(0.33 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	0.2 % + 0.15 µA 0.13 % + 0.15 µA 0.1 % + 0.15 µA 0.2 % + 0.2 µA 0.5 % + 0.3 µA 1 % + 0.6 µA	Fluke 5520A LCOMP Off
(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	0.18 % + 2 µA 0.09 % + 2 µA 0.04 % + 2 µA 0.08 % + 2 µA 0.2 % + 3 µA 0.4 % + 4 µA	
(33 to 330) 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	0.18 % + 20 µA 0.09 % + 20 µA 0.04 % + 20 µA 0.1 % + 50 µA 0.2 % + 100 µA 0.4 % + 200 µA	
(0.33 to 3) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.18 % + 100 µA 0.05 % + 100 µA 0.6 % + 1 mA 2.5 % + 5 mA	

Parameter/Range	Frequency	Best Uncertainty <sup>2,5</sup> ( $\pm$ )	Comments
AC Current <sup>3</sup> (cont.) – Generate			
(3 to 11) A	(1 to 5) kHz (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.06 % + 2 mA 0.1 % + 2 mA 3 % + 2 mA 0.12 % + 5 mA	Fluke 5520A LCOMP Off
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz	0.15 % + 5 mA 3 % + 5 mA	
AC Current <sup>3</sup> – Measure			
Up to 200 $\mu$ A	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.029 % + 20 nA 0.028 % + 20 nA 0.065 % + 20 nA 0.4 % + 20 nA	Fluke 8508A
200 $\mu$ A to 2 mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.029 % + 200 nA 0.028 % + 200 nA 0.065 % + 200 nA 0.4 % + 200 nA	HP 3458A
(2 to 20) mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.029 % + 2 $\mu$ A 0.028 % + 2 $\mu$ A 0.065 % + 2 $\mu$ A 0.4 % + 2 $\mu$ A	
(20 to 200) mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz	0.029 % + 20 $\mu$ A 0.025 % + 20 $\mu$ A 0.06 % + 20 $\mu$ A	
200 mA to 2 A	10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz	0.06 % + 200 $\mu$ A 0.07 % + 200 $\mu$ A 0.3 % + 200 $\mu$ A	
(2 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	0.08 % + 2 mA 0.25 % + 2 mA	
(10 to 100) $\mu$ A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.4 % + 10 nA 0.15 % + 10 nA 0.06 % + 10 nA 0.06 % + 10 nA	
(1 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.4 % + 20 $\mu$ A 0.15 % + 20 $\mu$ A 0.06 % + 20 $\mu$ A 0.03 % + 20 $\mu$ A	

Parameter/Range	Frequency	Best Uncertainty <sup>2,5</sup> ( $\pm$ )	Comments
AC Current <sup>3</sup> (cont.) – Measure			
(1 to 100) mA	(5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.06 % + 20 $\mu$ A 0.4 % + 40 $\mu$ A 0.55 % + 150 $\mu$ A	HP 3458A
(0.1 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	0.4 % + 0.02 mA 0.16 % + 0.02 mA 0.08 % + 0.02 mA 0.1 % + 0.02 mA 0.3 % + 0.02 mA 1.0 % + 0.04 mA	
AC Voltage <sup>3</sup> – Generate			
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	0.024 % + 4 $\mu$ V 90 $\mu$ Hz/Hz + 4 $\mu$ V 80 $\mu$ Hz/Hz + 4 $\mu$ V 0.02 % + 4 $\mu$ V 0.05 % + 5 $\mu$ V 0.11 % + 10 $\mu$ V 0.14 % + 20 $\mu$ V 0.27 % + 20 $\mu$ V	Fluke 5720A
(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	0.024 % + 4 $\mu$ V 90 $\mu$ Hz/Hz + 4 $\mu$ V 80 $\mu$ Hz/Hz + 4 $\mu$ V 0.02 % + 4 $\mu$ V 0.05 % + 5 $\mu$ V 0.11 % + 10 $\mu$ V 0.14 % + 20 $\mu$ V 0.27 % + 20 $\mu$ V	
(22 to 220) mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.024 % + 12 $\mu$ V 90 $\mu$ Hz/Hz + 7 $\mu$ V 80 $\mu$ Hz/Hz + 7 $\mu$ V 0.02 % + 7 $\mu$ V 0.046 % + 17 $\mu$ V 0.09 % + 20 $\mu$ V 0.14 % + 25 $\mu$ V 0.27 % + 45 $\mu$ V	
(0.22 to 2.2) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.024 % + 40 $\mu$ V 90 $\mu$ Hz/Hz + 15 $\mu$ V 45 $\mu$ Hz/Hz + 8 $\mu$ V 75 $\mu$ Hz/Hz + 10 $\mu$ V 0.011 % + 300 $\mu$ V 0.042 % + 80 $\mu$ V	

Parameter/Range	Frequency	Best Uncertainty <sup>2,5</sup> ( $\pm$ )	Comments
AC Voltage <sup>3</sup> (cont.) – Generate			
(0.22 to 2.2) V	(300 to 500) kHz 500 kHz to 1 MHz	0.1 % + 200 $\mu$ V 0.17 % + 300 $\mu$ V	Fluke 5720A
(2.2 to 22) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20kHz (20 to 50) kHz (50 to 100) KHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.024 % + 400 $\mu$ V 90 $\mu$ Hz/Hz + 150 $\mu$ V 45 $\mu$ Hz/Hz + 50 $\mu$ V 75 $\mu$ Hz/Hz + 100 $\mu$ V 0.01 % + 200 $\mu$ V 0.028 % + 600 $\mu$ V 0.1 % + 2 mV 0.15 % + 3.2 mV	
(22 to 220) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) KHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.024 % + 4 mV 90 $\mu$ Hz/Hz + 1.5 mV 52 $\mu$ Hz/Hz + 0.6 mV 80 $\mu$ Hz/Hz + 1 mV 0.015 % + 2.5 mV 0.09 % + 16 mV 0.44 % + 40 mV 0.8 % + 80 mV	Fluke 5720A, Volt- Hertz limitation over 100 kHz. Max output is 2.2 x 10 <sup>7</sup> V-Hz.
(220 to 1100) V	(15 to 50) Hz 50 Hz to 1 kHz	0.017 % + 6 mV 0.06 % + 11 mV	Max 250 V for (15 to 50) Hz
220 to 1100 V	(1 to 20) kHz (20 to 30) kHz	0.017 % + 6 mV 0.06 % + 11 mV	Fluke 5720A w/ 5725A
220 to 750 V	(30 to 50) kHz (50 to 100) kHz	0.06 % + 11 mV 0.23 % + 45 mV	
(1 to 33) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.08 % + 6 $\mu$ V 0.015 % + 6 $\mu$ V 0.02 % + 6 $\mu$ V 0.1 % + 6 $\mu$ V 0.35 % + 12 $\mu$ V 0.8 % + 50 $\mu$ V	Fluke 5520A
(33 to 330) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.05 % + 8 $\mu$ V 0.015 % + 8 $\mu$ V 0.016 % + 8 $\mu$ V 0.065 % + 8 $\mu$ V 0.08 % + 32 $\mu$ V 0.2 % + 70 $\mu$ V	
(0.33 to 3.3) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz	0.03 % + 50 $\mu$ V 0.015 % + 60 $\mu$ V 0.019 % + 60 $\mu$ V	

Parameter/Range	Frequency	Best Uncertainty <sup>2,5</sup> ( $\pm$ )	Comments
AC Voltage <sup>3</sup> (cont.) – Generate  (0.33 to 3.3) V	(20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.03 % + 50 $\mu$ V 0.07 % + 130 $\mu$ V 0.24 % + 0.6 mV	Fluke 5520A
AC Voltage – Measure  Up to 200 mV	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.016 % + 14 $\mu$ V 0.013 % + 4 $\mu$ V 0.011 % + 4 $\mu$ V 0.011 % + 2 $\mu$ V 0.011 % + 4 $\mu$ V 0.031 % + 8 $\mu$ V 0.071 % + 20 $\mu$ V	Fluke 8508A
Up to 200 mV	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz	0.014 % + 120 $\mu$ V 0.011 % + 20 $\mu$ V 85 $\mu$ V/V + 20 $\mu$ V 65 $\mu$ V/V + 20 $\mu$ V 85 $\mu$ V/V + 20 $\mu$ V 0.021 % + 40 $\mu$ V 0.051 % + 0.2 mV 0.3 % + 2 mV	Fluke 8508A
(0.2 to 2) V	300 kHz to 1 MHz	1 % + 20 mV	
(2 to 20) V	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.014 % + 1.2 mV 0.011 % + 0.2 mV 85 $\mu$ V/V + 0.2 mV 65 $\mu$ V/V + 0.2 mV 85 $\mu$ V/V + 0.2 mV 0.021 % + 0.4 mV 0.051 % + 2 mV 0.3 % + 20 mV 1 % + 200 mV	
(20 to 200) V	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.014 % + 1.2 mV 0.011 % + 0.2 mV 85 $\mu$ V/V + 0.2 mV 65 $\mu$ V/V + 0.2 mV 85 $\mu$ V/V + 0.2 mV 0.021 % + 0.4 mV 0.051 % + 2 mV 0.3 % + 20 mV 1 % + 200 mV	

Parameter/Range	Frequency	Best Uncertainty <sup>2, 5</sup> ( $\pm$ )	Comments
AC Voltage (cont.) – Measure			
(200 to 300) V	(1 to 10) Hz (10 to 40) Hz 40 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.014 % + 70 parts in $10^6$ 0.011 % + 20 parts in $10^6$ 95 $\mu$ V/V + 20 parts in $10^6$ 0.021 % + 40 parts in $10^6$ 0.051 % + 200 parts in $10^6$	Fluke 8508A
(300 to 1000) V	(1 to 10) Hz (10 to 40) Hz 40 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.034 % + 70 mV 0.031 % + 20 mV 0.13 % + 20 mV 0.14 % + 40 mV 0.17 % + 200 mV	Fluke 5790A/03
600 $\mu$ V 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	0.17 % + 1.3 $\mu$ V 0.074 % + 1.3 $\mu$ V 0.042 % + 1.3 $\mu$ V 0.081 % + 2 $\mu$ V 0.12 % + 2.5 $\mu$ V 0.23 % + 4 $\mu$ V 0.24 % + 8 $\mu$ V	
Flatness – 500 kHz to 30 MHz (Relative to 1 kHz)	500 kHz to 1.2 MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.07 % + 1 $\mu$ V 0.07 % + 1 $\mu$ V 0.10 % + 1 $\mu$ V 0.17 % + 1 $\mu$ V 0.37 % + 2 $\mu$ V	
(2.2 to 7) 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	0.085 % + 1.3 $\mu$ V 0.037 % + 1.3 $\mu$ V 0.021 % + 1.3 $\mu$ V 0.04 % + 2 $\mu$ V 0.06 % + 2.5 $\mu$ V 0.12 % + 4 $\mu$ V 0.13 % + 8 $\mu$ V	
Flatness – 500 kHz to 30 MHz (Relative to 1 kHz)	500 kHz to 1.2 MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.07 % + 1 $\mu$ V 0.07 % + 1 $\mu$ V 0.10 % + 1 $\mu$ V 0.17 % + 1 $\mu$ V 0.37 % + 1 $\mu$ V	
(7 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	0.029 % + 1.3 $\mu$ V 0.019 % + 1.3 $\mu$ V 0.011 % + 1.3 $\mu$ V 0.021 % + 2 $\mu$ V 0.031 % + 2.5 $\mu$ V 0.81 % + 4 $\mu$ V 0.089 % + 8 $\mu$ V	

Parameter/Range	Frequency	Best Uncertainty <sup>2,5</sup> ( $\pm$ )	Comments
AC Voltage (cont.) – Measure			Fluke 5790A/03
Flatness – 500 kHz to 30 MHz (Relative to 1 kHz)	500 kHz to 1.2 MHz	0.07 %	
	(1.2 to 2) MHz	0.07 %	
	(2 to 10) MHz	0.10 %	
	(10 to 20) MHz	0.17 %	
	(20 to 30) MHz	0.37 %	
Flatness – (22 to 70) mV	(10 to 20) Hz	0.024 % + 1.5 $\mu$ V	
	(20 to 40) Hz	0.012 % + 1.5 $\mu$ V	
	40 Hz to 20 kHz	65 $\mu$ V/V + 1.5 $\mu$ V	
	(20 to 50) kHz	0.013 % + 2 $\mu$ V	
	(50 to 100) kHz	0.026 % + 2.5 $\mu$ V	
	(100 to 300) kHz	0.051 % + 4 $\mu$ V	
Flatness – 500 kHz to 30 MHz (Relative to 1 kHz)	500 kHz to 1.2 MHz	0.05 %	
	(1.2 to 2) MHz	0.05 %	
	(2 to 10) MHz	0.10 %	
	(10 to 20) MHz	0.15 %	
	(20 to 30) MHz	0.35 %	
(70 to 220) mV	(10 to 20) Hz	0.021 %	
	(20 to 40) Hz	82 $\mu$ V/V	
	40 Hz to 20 kHz	34 $\mu$ V/V	
	(20 to 50) kHz	67 $\mu$ V/V	
	(50 to 100) kHz	0.016 % + 2.5 $\mu$ V	
	(100 to 300) kHz	0.025 % + 4 $\mu$ V	
Flatness – 500 kHz to 30 MHz (Relative to 1 kHz)	500 kHz to 1.2 MHz	0.05 %	
	(1.2 to 2) MHz	0.05 %	
	(2 to 10) MHz	0.10 %	
	(10 to 20) MHz	0.15 %	
	(20 to 30) MHz	0.35 %	
(220 to 700) mV	(10 to 20) Hz	0.021 %	
	(20 to 40) Hz	73 $\mu$ V/V	
	40 Hz to 20 kHz	27 $\mu$ V/V	
	(20 to 50) kHz	47 $\mu$ V/V	
	(50 to 100) kHz	79 $\mu$ V/V + 2.5 $\mu$ V	
	(100 to 300) kHz	0.018 % + 4 $\mu$ V	
Flatness – 500 kHz to 30 MHz (Relative to 1 kHz)	500 kHz to 1.2 MHz	0.05 %	
	(1.2 to 2) MHz	0.05 %	
	(2 to 10) MHz	0.10 %	
	(10 to 20) MHz	0.15 %	
	(20 to 30) MHz	0.35 %	

Parameter/Range	Frequency	Best Uncertainty <sup>2,5</sup> ( $\pm$ )	Comments
AC Voltage (cont.) – Measure			
Flatness – 500 kHz to 30 MHz (Relative to 1 kHz)			
700 mV to 2.2 V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz	0.02 % 63 $\mu$ V/V 18 $\mu$ V/V 43 $\mu$ V/V 71 $\mu$ V/V 0.016 % 0.026 %	Fluke 5790A/03
(2.2 to 7) V	500 kHz to 1.2 MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.05 % 0.05 % 0.10 % 0.15 % 0.35 %	
Flatness – 500 kHz to 30 MHz (Relative to 1 kHz)	(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	0.02 % 63 $\mu$ V/V 18 $\mu$ V/V 44 $\mu$ V/V 81 $\mu$ V/V 0.019 % 0.04 %	
(7 to 22) V	500 kHz to 1.2 MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.05 % 0.05 % 0.10 % 0.15 % 0.35 %	
(22 to 70) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.02 % 63 $\mu$ V/V 21 $\mu$ V/V 44 $\mu$ V/V 81 $\mu$ V/V 0.019 % 0.04 % 0.12 %	
(70 to 220) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.02 % 63 $\mu$ V/V 25 $\mu$ V/V 55 $\mu$ V/V 94 $\mu$ V/V 0.02 %	

Parameter/Range	Frequency	Best Uncertainty <sup>2,5</sup> ( $\pm$ )	Comments
AC Voltage (cont.) – Measure			
(70 to 220) V	(300 to 500) kHz 500 kHz to 1 MHz	0.041 % 0.12 %	Fluke 5790A/03
	(10 to 20) Hz	0.02 %	
	(20 to 40) Hz	63 $\mu$ V/V	
	40 Hz to 20 kHz	23 $\mu$ V/V	
	(20 to 50) kHz	63 $\mu$ V/V	
	(50 to 100) kHz	98 $\mu$ V/V	
	(100 to 300) kHz	0.021 %	
	(300 to 500) kHz	0.05 %	
(220 to 700) V	(10 to 20) Hz	0.02 %	
	(20 to 40) Hz	92 $\mu$ V/V	
	40 Hz to 20 kHz	36 $\mu$ V/V	
	(20 to 50) kHz	0.013 %	
	(50 to 100) kHz	0.05 %	
(700 to 1000) V	(10 to 20) Hz	0.02 %	
	(20 to 40) Hz	92 $\mu$ V/V	
	40 Hz to 20 kHz	33 $\mu$ V/V	
	(20 to 50) kHz	0.013 %	
	(50 to 100) kHz	0.05 %	
Phase <sup>3</sup> – Generate	(10 to 65) Hz	0.1°	Fluke 5520A
	(65 to 500) Hz	0.25°	
	500 Hz to 1 kHz	0.5°	
	(1 to 5) kHz	2.5°	
	(5 to 10) kHz	5°	
	(10 to 30) kHz	10°	

Parameter/Equipment	Range	Best Uncertainty <sup>2,5</sup> ( $\pm$ )	Comments
Capacitance <sup>3</sup> – Generate	(0.19 to 3.3) nF	0.5 % + 0.01 nF	Fluke 5520A
	(3.3 to 11) nF	0.25 % + 0.01 nF	
	(11 to 110) nF	0.25 % + 0.1 nF	
	(110 to 330) nF	0.25 % + 0.3 nF	
	(0.33 to 1.1) $\mu$ F	0.25 % + 1 nF	
	(1.1 to 3.3) $\mu$ F	0.25 % + 3 nF	
	(3.3 to 11) $\mu$ F	0.25 % + 10 nF	

Parameter/Equipment	Range	Best Uncertainty <sup>2</sup> ( $\pm$ )	Comments
Capacitance <sup>3</sup> (cont.) – Generate	(11 to 33) $\mu$ F (33 to 110) $\mu$ F (110 to 330) $\mu$ F (0.33 to 1.1) mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF	0.4 % + 30 nF 0.45 % + 100 nF 0.45 % + 300 nF 0.45 % + 1 $\mu$ F 0.45 % + 3 $\mu$ F 0.45 % + 10 $\mu$ F 0.75 % + 30 $\mu$ F 0.46 % + 100 $\mu$ F	Fluke 5520A
Electrical Calibration of Thermocouples <sup>3</sup> –			
Type B	600 °C to 800 °C 800 °C to 1000 °C 1000 °C to 1550 °C 1550 °C to 1820 °C	0.44 °C 0.34 °C 0.3 °C 0.33 °C	Fluke 5520A
Type C	0 °C to 150 °C 150 °C to 650 °C 650 °C to 1000 °C 1000 °C to 1800 °C 1800 °C to 2316 °C	0.30 °C 0.26 °C 0.31 °C 0.5 °C 0.84 °C	
Type E	-250 °C to -100 °C -100 °C to 25 °C -25 °C to 350 °C 350 °C to 650 °C 650 °C to 1000 °C	0.5 °C 0.16 °C 0.14 °C 0.16 °C 0.21 °C	
Type J	-210 °C to -100 °C -100 °C to -30 °C -30 °C to 150 °C 150 °C to 760 °C 760 °C to 1200 °C	0.27 °C 0.16 °C 0.14 °C 0.17 °C 0.23 °C	
Type K	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 1000 °C 1000 °C to 1372 °C	0.33 °C 0.18 °C 0.16 °C 0.26 °C 0.4 °C	
Type L	-200 °C to -100 °C -100 °C to 800 °C 800 °C to 900 °C	0.37 °C 0.26 °C 0.17 °C	
Type N	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 410 °C 410 °C to 1300 °C	0.4 °C 0.22 °C 0.19 °C 0.18 °C 0.27 °C	

Parameter/Equipment	Range	Best Uncertainty <sup>2</sup> , (±)	Comments
Electrical Calibration of Thermocouples <sup>3</sup> (cont.)–			
Type R	0 °C to 250 °C 250 °C to 400 °C 400 °C to 1000 °C 1000 °C to 1767 °C	0.57 °C 0.35 °C 0.33 °C 0.4 °C	Fluke 5520A
Type S	0 °C to 250 °C 250 °C to 1000 °C 1000 °C to 1400 °C 1400 °C to 1767 °C	0.47 °C 0.36 °C 0.37 °C 0.46 °C	
Type T	-250 °C to -150 °C -150 °C to 0 °C 0 °C to 120 °C 120 °C to 400 °C	0.63 °C 0.24 °C 0.16 °C 0.14 °C	
Type U	-200 °C to 0 °C 0 °C to 600 °C	0.56 °C 0.27 °C	
Electrical Calibration of RTD <sup>3</sup> –			
Pt 385, 100 Ω	-200 °C to 0 °C 0 °C to 100 °C 100 °C to 300 °C 300 °C to 400 °C 400 °C to 630 °C	0.05 °C 0.07 °C 0.09 °C 0.12 °C 0.12 °C	Fluke 5520A
Pt 385, 100 Ω	630 °C to 800 °C	0.23 °C	
Pt 3926, 100 Ω	-200 °C to 0 °C 0 °C to 100 °C 100 °C to 300 °C 300 °C to 400 °C 400 °C to 630 °C	0.05 °C 0.07 °C 0.09 °C 0.1 °C 0.12 °C	
Pt 3916, 100 Ω	-200 °C to -190 °C -190 °C to -80 °C -80 °C to 0 °C 0 °C to 100 °C 100 °C to 260 °C 260 °C to 300 °C 300 °C to 400 °C 400 °C to 600 °C 600 °C to 630 °C	0.25 °C 0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.08 °C 0.09 °C 0.1 °C 0.23 °C	

Parameter/Equipment	Range	Best Uncertainty <sup>2,5</sup> ( $\pm$ )	Comments
AC Power <sub>3</sub> Low Frequency <sup>3</sup> –  3.3 mA to 21 A (45 to 65) Hz	(33 to 330) mV (0.33 to 1020) V	0.14 % 0.12 %	Fluke 5520A
DC Power <sup>3</sup> –  (0.33 to 30) mA (0.33 to 3) A (3 to 21) A	33 mV to 1020 V 33 mV to 1020 V 33 mV to 1020 V	0.023 % 0.022 % 0.07 %	Fluke 5520A
Oscilloscope Calibration <sup>3</sup> –  Squarewave Signal  (50 $\Omega$ at 1 kHz)  (1 M $\Omega$ at 1 kHz)  Leveled Sine Wave  Amplitude (50 kHz ref.)  Flatness (rel. to 50 kHz)  Time Marker (50 $\Omega$ Source and Period)  Rise Time	(1 to 110) mV 110 mV to 2.2 V (2.2 to 11) V (11 to 1100) V  (1 to 110) mV 110 mV to 2.2 V (2.2 to 11) V (11 to 1100) V  50 kHz reference 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz  50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz  5 s to 50 ms 20 ms to 2 ns  $\leq$ 350 ps	0.28 % + 48 $\mu$ V 0.28 % + 120 $\mu$ V 0.28 % + 1.2 mV 0.28 % + 12 mV  0.12 % + 48 $\mu$ V 0.12 % + 120 $\mu$ V 0.12 % + 1.2 mV 0.12 % + 12 mV  2 % + 300 $\mu$ V 3.5 % + 300 $\mu$ V 4 % + 300 $\mu$ V 6 % + 300 $\mu$ V  1.5 % + 100 $\mu$ V 2 % + 100 $\mu$ V 4 % + 100 $\mu$ V  26 ns + 0.07 ms 2.6 ns  +0 / -100 ps	Fluke 5520A/SC600

<sup>1</sup> This laboratory offers commercial and on-site calibration service.

- <sup>2</sup> “Best Uncertainty” is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards of nearly ideal measuring equipment. Best uncertainties represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of  $k = 2$ . The best uncertainty of a specific calibration performed by the laboratory may be greater than the best uncertainty due to the behavior of the customer’s device, to the environment and to influences from the circumstances of the specific calibration.
- <sup>3</sup> On-site calibration service is available for this calibration. The uncertainties achievable on a customer's site can normally be expected to be larger than the Best Measurement Capabilities (BMC) that the accredited laboratory has been assigned as Best Uncertainty on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the calibration uncertainty being larger than the BMC.
- <sup>4</sup> In the statement of best uncertainty,  $L$  is the numerical value of the nominal length of the device measured in inches,  $R$  is the numerical value of the resolution of the device in microinches,  $D$  is the numerical value of the nominal diameter of the device measured in inches.
- <sup>5</sup> In the statement of best uncertainty, the value is defined as the percentage of reading.