



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

LABORATORY TESTING, INC. dba LTI Metrology
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CALIBRATION

Valid To: March 31, 2013

Certificate Number: 117.04

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations¹:

Dimensional

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Gage Blocks	Up to 4 in (5 to 20) in	3.7 µin (4 + 1.3L) µin	Mechanical comparison with reference blocks
Length Standards	(1 to 40) in >40 to 60 in	(17 + 2.4L) µin (133 + 6.0L) µin	Mahr 2000
Calipers ³	(6 to 96) in	(18 + 4.2L + 0.6R) µin	Gage blocks
Micrometers ³ –			
Outside	(0 to 1) in (>1 to 6) in (>6 to 24) in	60 µin (51 + 9.4L) µin (79 + 8.3L) µin	Gage Blocks
Disc Micrometers	(0 to 1) in	130 µin	
Inside Micrometers	(0 to 40) in	(130 + 1.3L) µin	UMM

Parameter/Equipment	Range	CMC ^{2,4} (\pm)	Comments
Height Gages	(1 to 48) in	$(450 + 0.5L + 0.6R) \mu\text{in}$	Gage blocks surface plate
Indicators – Dial/Digital	Up to 2 in	$(29 + 0.6R) \mu\text{in}$	Indicator calibrator
Optical Comparators ³ – Linearity Magnification Angularity	(0 to 12) in (10x, 20x, 31.25x), (50x, 62.5x) (0 to 360) ^o	$(650 + 0.6R) \mu\text{in}$ $(710 + 0.6R) \mu\text{in}$ $(760 + 0.6R) \mu\text{in}$ 0°, 1', 17"	Accurite reticle and inspection scale
Pin Gages	Up to 1 in	19 μin	UMM, Pratt & Whitney Supermicrometer®
Plugs	Up to 1.5 in 1.5 to 3.0	13 μin 16 μin	Federal comparator
Radius Gages	Up to 1 in	430 μin	Video measuring machine
Threaded Plugs – Major Diameter Pitch Diameter	Up to 3.5 in (3.5 to 6.5) in Up to 1.5 in (>1.5 to 3.5) in (>3.5 to 6.5) in	28 μin 30 μin 64 μin 130 μin 150 μin	UMM and Pratt & Whitney Supermicrometer®
Thread Wires (1-Wire)	Up to 0.26 in	16 μin	Mahr 828
Plain Rings	0.04 to 1.5 in 1.5 to 3.0 in	17 μin 24 μin	Comparator

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Adjustable Thread Rings – Minor Diameter Pitch Diameter	Up to 0.425 in (>0.425 to 2.8) in (>2.8 to 6.6) in Up to 1.5 in (>1.5 to 3.5) in (>3.5 to 6.5) in	82 µin 130 µin 140 µin 140 µin 180 µin 190 µin	Bore gage Video measuring machine Set plug
Tapered Thread Rings – Standoff L1 Length	(0 to 6) in (0 to 6) in	0.0002 in 0.0001 in	Gage blocks
Tapered Thread Plugs Pitch Diameter L1 Length	(0 to 6) in (0 to 6) in	0.00013 in 0.0001 in	Gage blocks, Supermicrometer®, thread wires
Rules	Up to 18 in (>18 to 78) in	170 µin (3100 + 0.7L) µin	Gage blocks, vision system
Surface Plates ³	16 to 195 in diagonal	(14 + 0.2L) µin 23 µin	Electronic levels Repeat-O-Meter
Pratt & Whitney Supermicrometer® / Bench Micrometers ³	(0 to 2) in	20 µin	Gage blocks
CMM ³ – Repeatability Linearity Bi-Directional Linearity Volumetric	Up to 1 in Up to 36 in 1” (6 to 18) in cube (18 to 40) in cube	51 µin (60 + 10L) µin 25 µin (0 + 23L) µin (1.4 + 23L) µin	Sphere Step gage Gage blocks Ball bar

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ² (±)	Comments
DC Voltage – Measure	Up to 200 mV 200 mV to 2 V (2 to 20) V (20 to 200) V (200 to 1000) V	13 μV/V 4 μV/V 4 μV/V 36 μV/V 110 μV/V	Fluke 8508A
DC Voltage – Generate	(0 to 330) mV 330 mV to 3.3 V (3.3 to 33) V (33 to 330) V (330 to 1000) V	32 μV/V 13 μV/V 14 μV/V 20 μV/V 21 μV/V	Fluke 5520A
DC Current – Measure	Up to 200) μA 200 μA to 2 mA (2 to 20) mA (20 to 200) mA 200 mA to 2 A (2 to 20) A	17 μA/A 15 μA/A 17 μA/A 52 μA/A 200 μA/A 430 μA/A	Fluke 8508A
DC Current – Generate	(0 to 330) μA 330 μA to 3.9 mA (3.3 to 33) mA (33 to 330) mA 330 mA to 1.1 A (1.1 to 3.0) A (3 to 11) A (11 to 20.5) A	150 μA/A 100 μA/A 100 μA/A 110 μA/A 240 μA/A 420 μA/A 1 mA/A 1.8 mA/A	Fluke 5520A
Clamp On Only	(20 to 1000) A	13 % output 6.8 % output 5.5 % output 5.3 % output	Fluke 5500A/coil
DC Resistance – Measure	Up to 2 Ω (2 to 20) Ω (20 to 200) Ω 200 Ω to 2 kΩ (2 to 20) kΩ (20 to 200) kΩ 200 kΩ to 2 MΩ (2 to 20) MΩ (20 to 200) MΩ 200 MΩ to 2 GΩ 2 GΩ	27 μΩ/Ω 12 μΩ/Ω 9 μΩ/Ω 8 μΩ/Ω 9 μΩ/Ω 8 μΩ/Ω 18 μΩ/Ω 180 μΩ/Ω 1.6 mΩ/Ω 16 mΩ/Ω 2.1 mΩ/Ω	Fluke 8508A

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation of RTDs –			
Pt 385, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.04° C 0.05° C 0.07° C 0.08° C 0.09° C 0.18° C	Fluke 5520A
Pt 3926, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.04° C 0.05° C 0.07° C 0.08° C 0.09° C	
Pt 3916, 100 Ω	(-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.19° C 0.03° C 0.04° C 0.05° C 0.05° C 0.06° C 0.07° C 0.08° C 0.18° C	
DC Resistance – Generate	(0 to 11) Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω 330 Ω to 1.1 kΩ (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 1.1 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	44 μΩ/Ω 31 μΩ/Ω 29 μΩ/Ω 28 μΩ/Ω 28 μΩ/Ω 28 μΩ/Ω 28 μΩ/Ω 28 μΩ/Ω 28 μΩ/Ω 32 μΩ/Ω 32 μΩ/Ω 190 μΩ/Ω 220 μΩ/Ω 260 μΩ/Ω 510 μΩ/Ω 3.1 mΩ/Ω 15 mΩ/Ω	Fluke 5520A

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation of Thermocouples –			
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.45° C 0.26° C 0.26° C 0.26° C 0.28° C	Fluke 5520A
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.31° C 0.26° C 0.26° C 0.27° C 0.29° C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.35° C 0.27° C 0.26° C 0.31° C 0.39° C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.50° C 0.36° C 0.37° C 0.39° C	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.43° C 0.36° C 0.37° C 0.43° C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.54° C 0.30° C 0.26° C 0.26° C	

Parameter/Range	Frequency	CMC ² (±)	Comments
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	260 μV/V 190 μV/V 170 μV/V 160 μV/V 160 μV/V 380 μV/V 870 μV/V	Fluke 8508A
200 mV to 2V	(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 1MHz	230 μV/V 150 μV/V 130 μV/V 110 μV/V 140 μV/V 240 μV/V 670 μV/V 4.1 mV/V 21 mV/V	
(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 1MHz	220 μV/V 130 μV/V 110 μV/V 87 μV/V 130 μV/V 250 μV/V 670 μV/V 4 mV/V 20 mV/V	
(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 1MHz	220 μV/V 130 μV/V 110 μV/V 87 μV/V 130 μV/V 250 μV/V 680 μV/V 4.1 mV/V 20 mV/V	
(200 to 1000)V	(1 to 10) Hz (10 to 40) Hz 40 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	480 μV/V 470 μV/V 490 μV/V 570 μV/V 1.2 mV/V	

Parameter/Range	Frequency	CMC ² (±)	Comments
AC Voltage – Measure (cont)			
1000 V	(1 to 10) Hz (10 to 40) Hz 40 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	480 μV/V 470 μV/V 490 μV/V 570 μV/V 1.2 mV/V	Fluke 5520A
AC Voltage – Generate			
(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	1.6 mV/V 770 μV/V 820 μV/V 2.1 mV/V 4.9 mV/V 14 mV/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	400 μV/V 230 μV/V 240 μV/V 430 μV/V 1.2 mV/V 2.7 mV/V	
330 mV to 3.3 V	(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	360 μV/V 230 μV/V 260 μV/V 350 μV/V 860 μV/V 3.1 mV/V	
(3.3 to 33) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	370 μV/V 220 μV/V 310 μV/V 410 μV/V 1.1 mV/V	
(33 to 330) V	45 Hz to 1 kHz (1 to 10) kHz	220 μV/V 260 μV/V	
(33 to 330) V	(10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	320 μV/V 370 μV/V 2.6 mV/V	
(330 to 1020) V	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	550 μV/V 530 μV/V 550 μV/V	

Parameter/Range	Frequency	CMC ² (±)	Comments
AC Current – Measure			
Up to 200 µA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	810 µA/A 810 µA/A 890 µA/A 0.42 % output	Fluke 8508A
200 µA to 20 mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	760 µA/A 750 µA/A 810 µA/A 0.41 % output	
(20 to 200) mA	10 to 10 kHz (10 to 30) kHz (30 to 100) kHz	500 µA/A 810 µA/A 0.41 % output	
200 mA to 2A	(10 to 2) kHz (2 to 10) kHz (10 to 30) kHz	600 µA/A 810 µA/A 0.41 % output	
(2 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	930 µA/A 0.26 % output	
AC Current – Measure, Fixed Points			
2A	10 Hz to 10 kHz (2 to 10) kHz (10 to 30) kHz	720 µA/A 830 µA/A 0.31 % output	Fluke 8508A

Parameter/Range	Frequency	CMC ² (±)	Comments
AC Current – Generate			
(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	0.29 % output 0.26 % output 0.24 % output 0.39 % output 0.88 % output 1.8 % output	Fluke 5520A
330 µA 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	0.21 % output 0.15 % output 0.39 % output 0.22 % output 0.51 % output 1.1 % output	
(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	0.19 % output 0.10 % output 0.05 % output 0.09 % output 0.21 % output 0.41 % output	
(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	0.19 % output 0.06 % output 0.05 % output 0.12 % output 0.23 % output 0.46 % output	
330 mA to 1.1 A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.19 % output 0.06 % output 0.69 % output 3.0 % output	
(1.1 to 3) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.18 % output 0.06 % output 0.63 % output 2.7 % output	
(3 to 11) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.08 % output 0.12 % output 3.1 % output	
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.14 % output 0.15 % output 3.1 % output	

Parameter/Range	Frequency	CMC ² (±)	Comments
AC Current – Generate (cont)			
(20.5 to 55) A	(45 to 65) Hz (65 to 440) Hz	9.5 % output 14 % output	Fluke 5500A coil and Fluke 5520A
(55 to 150)A	(45 to 65) Hz (65 to 440) Hz	14 % output 13 % output	
(150 to 550)A	(45 to 65) Hz (65 to 440) Hz	6.5 % output 6.8 % output	
(550 to 1025)A	(45 to 65) Hz (65 to 440) Hz	9.1 % output 9.4 % output	

III. Mechanical

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Balances	Up to 1 lb (>1 to 5) lb (>5 to 10) lb (>10 to 50) lb (>50 to 500) lb (>500 to 1000) lb Up to 500 g	0.21 mg 32 mg 52 mg 320 mg 190 g 480 g 0.22 mg	Class 1 weights Class F weights
Deadweight Testers	Up to 40 000 psi	0.04 % rdg	DWT & weights
Force	Up to 500 lbf (>500 to 100 000) lbf	1.2 g + 0.6R 0.35 % rdg	Dead weight, load cells
Mass	1 mg (>1 to 50) mg (>50 to 500) mg (>1 to 5) g (>5 to 50) g (>50 to 200) g (>200 to 500) g (>500 to 6200) g Up to 50 lbs	0.4 mg 1.1 mg 1.9 mg 0.03 mg 0.04 mg 0.07 mg 0.1 mg 0.05 g 0.33 g	Class 1 weights

Parameter/Equipment	Range	CMC ^{2,4} (\pm)	Comments
Torque Wrenches	(5 to 100) in·lb (10 to 200) ft·lbs (201 to 2000) ft·lbs	(0.004 + 0.001 <i>T</i>) in·lb + 0.6 <i>R</i> (0.003 + 0.001 <i>T</i>) ft·lbs + 0.6 <i>R</i> (0.033 + 0.001 <i>T</i>) ft·lbs + 0.6 <i>R</i>	Torque calibrator
Indirect Verification of Rockwell Hardness Testers ³	HR15N HR15T HR30N HRN30T HRN45N HRN45T HRB High Mid Low HRC High Mid Low	0.23 HR15N 0.31 HR15T 0.29 HR30N 0.33 HR30T 0.23 HR45N 0.4 HRN45T 0.46 HRB 0.65 HRB 1 HRB 0.32 HRC 0.34 HRC 0.44 HRC	Hardness blocks
Pressure	(0 to 30) psi (0 to 1000) psi (2000 to 20 000) psi (20 000 to 40 000) psi	0.012 % rdg 0.013 % rdg 0.014 % rdg 0.019 % rdg	DHI instruments PPC4 module RPM4 module

IV. Thermodynamics

Parameter/Equipment	Range	CMC ² (±)	Comments
Temperature – Measuring Equipment	-197 °C (-197,- 40, 0, 100) °C 200 °C 300 °C (400 and 500) °C	0.01 °C 0.02 °C 0.03 °C 0.04 °C 0.03 °C	PRT and baths
Temperature – Measure	(-197 to 300)°C (400 to 500) °C	0.01 °C 0.02 °C	PRT
Temperature – Ovens and Furnaces	(0 to 1093) °C (1093 to 1327) °C	2.1 °C 2.7 °C	Type K TC Fluke 744

¹ This laboratory offers commercial calibration service and field calibration service.

² Calibration and Measurement Capability (CMC) 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 or nearly ideal measuring equipment. Calibration and Measurement Capabilities represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of $k = 2$. The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

³ Field calibration service is available for this calibration and this laboratory meets A2LA R104 – *General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for these calibrations. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found 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 actual uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.

⁴ In the statement of CMC, 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 the indicated units. In the Statement of CMC, T is the numerical value of the nominal torque of the device measured in ft-lbs or in-lbs.



World Class Accreditation

The American Association for Laboratory Accreditation

Accredited Laboratory

A2LA has accredited

LABORATORY TESTING, INC. dba LTI METROLOGY

Hatfield, PA

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 8 January 2009*).

Presented this 8th day of June 2011.





President & CEO

For the Accreditation Council
Certificate Number 117.04
Valid to March 31, 2013

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