



THE AMERICAN ASSOCIATION FOR
LABORATORY ACCREDITATION

ACCREDITED LABORATORY

A2LA has accredited

FIRSTENERGY BETA LABORATORY

Mayfield Village, OH

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 January 2009*).



Presented this 27th day of February 2009.

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

President
For the Accreditation Council
Certificate Number 2489.01
Valid to November 30, 2010

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

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

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CALIBRATION

Valid To: November 30, 2010

Certificate Number: 2489.01

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

I. Dimensional

Parameter/Equipment	Range	Best Uncertainty ^{2,3} (\pm)	Comments
Micrometers – Inside Outside	(0 to 12) in (0 to 12) in	$(300 + 150L + 0.6R) \mu\text{in}$ $(340 + 44L + 0.6R) \mu\text{in}$	Comparison to gage blocks
Calipers	(0 to 12) in	$(340 + 44L + 0.6R) \mu\text{in}$	Comparison to gage blocks
Dial Indicators	(0 to 2) in	$(90 + 14L + 0.6R) \mu\text{in}$	Comparison to gage blocks
Depth Gages	(0 to 12) in	$(430 + 83L + 0.6R) \mu\text{in}$	Comparison to gage blocks

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	Best Uncertainty ^{2,4} (±)	Comments
DC Voltage – Generate	(0 to 220) mV (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V	12 μV/V + 0.4 μV 6.2 μV/V + 0.7 μV 4.3 μV/V + 2.5 μV 4.3 μV/V + 4.0 μV 6 μV/V + 40 μV 8 μV/V + 0.4 μV	Fluke 5720A
DC Current – Generate	(0 to 220) μA (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A	0.012 % + 6 nA 50 μA/A + 7 nA 47 μA/A + 40 nA 70 μA/A + 0.7 μA 0.015 % + 12 μA	Fluke 5720A
DC Voltage – Measure	(0 to 200) mV (0.2 to 2) V (2 to 20) V (20 to 200) V (200 to 1000) V	7.8 μV/V + 0.1 μV 5.0 μV/V + 1 μV 4.8 μV/V + 4 μV 6.4 μV/V + 40 μV 7.0 μV/V + 0.53 mV	Fluke 8508A
DC Current – Measure	(0 to 200) μA (0.2 to 2) mA (2 to 20) mA (20 to 200) mA (0.2 to 2) A (2 to 20) A	20 μA/A + 0.4 nA 20 μA/A + 4 nA 22 μA/A + 40 nA 54 μA/A + 0.8 μA 0.02 % + 16 μA 0.05 % + 0.4 mA	Fluke 8508A
Capacitance – Generate	(0.33 to 0.4) nF (0.4 to 1) nF (1 to 2) nF (2 to 5) nF (5 to 10) nF (10 to 20) nF (20 to 50) nF (50 to 100) nF (100 to 200) nF 200 nF to 1 μF	3.5 % + 0.01 nF 1.8 % + 0.01 nF 1.2 % + 0.01 nF 0.81 % + 0.01 nF 0.69 % + 0.01 nF 0.87 % + 0.1 nF 0.52 % + 0.1 nF 0.41 % + 0.1 nF 0.55 % + 0.3 nF 0.41 % + 1 nF	Fluke 5500A

Parameter/Equipment	Range	Best Uncertainty ^{2,4} (±)	Comments
Capacitance – Generate (cont)	(1 to 2) μF (2 to 5) μF (5 to 10) μF (10 to 20) μF (20 to 30) μF (30 to 50) μF (50 to 100) μF (100 to 200) μF (200 to 300) μF 300 μF to 1 mF	0.58 % + 3 nF 0.64 % + 10 nF 0.52 % + 10 nF 0.64 % + 30 nF 0.58 % + 30 nF 0.81 % + 100 nF 0.7 % + 100 nF 1.1 % + 300 nF 0.95 % + 300 nF 1.2 % + 300 nF	Fluke 5500A
Resistance – Measure	(0 to 1) Ω (1 to 10) Ω (10 to 100) Ω 100 Ω to 1 k Ω (1 to 10) k Ω (10 to 100) k Ω (0.1 to 1) M Ω (1 to 10) M Ω (10 to 100) M Ω (0.1 to 1) G Ω	50 $\mu\Omega$ 0.28 m Ω 2.1 m Ω 21 m Ω 0.21 Ω 2.1 Ω 25 Ω 660 Ω 39 k Ω 3.8 M Ω	Fluke 8508A
Resistance – Generate Fixed Points 2 Wire 4 Wire	100 k Ω 190 k Ω 1 M Ω 1.9 M Ω 10 M Ω 19 M Ω 100 M Ω 0 Ω 0 Ω 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 k Ω 1.9 k Ω 10 k Ω 19 k Ω	1.3 Ω 2.5 Ω 24 Ω 47 Ω 0.5 k Ω 1.1 k Ω 13 k Ω 0.2 Ω 47 $\mu\Omega$ 0.11 m Ω 0.21 m Ω 0.28 m Ω 0.53 m Ω 1.2 m Ω 2.3 m Ω 11 m Ω 20 m Ω 0.1 Ω 0.2 Ω	Fluke 5720A

Parameter/Equipment	Range	Best Uncertainty ² (±)	Comments
Electrical Calibration of Thermocouple Indication Systems –			
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.51 °C 0.40 °C 0.35 °C 0.38 °C	Fluke 5500A
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.58 °C 0.19 °C 0.17 °C 0.19 °C 0.25 °C	
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 0.19 °C 0.17 °C 0.21 °C 0.27 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.39 °C 0.22 °C 0.19 °C 0.31 °C 0.47 °C	
Type N	(-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.47 °C 0.26 °C 0.22 °C 0.32 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.66 °C 0.41 °C 0.39 °C 0.47 °C	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.55 °C 0.42 °C 0.43 °C 0.54 °C	
Type T	(-250 to 150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.73 °C 0.28 °C 0.19 °C 0.17 °C	

Parameter/Range	Frequency	Best Uncertainty ^{2,4} (±)	Comments
Temperature – RTD Simulated Generate	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.03 °C 0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.08 °C 0.1 °C	ESI RS925D (based on platinum RTD 385)
AC Voltage – Measure			Fluke 8508A
(0 to 200) mV	20 Hz to 30 kHz (30 to 100) kHz	0.04 % + 8 µV 0.1 % + 20 µV	
(0.2 to 2) V	20 Hz to 30 kHz (30 to 100) kHz 100 kHz to 1 MHz	0.03 % + 40 µV 0.08 % + 0.2 mV 3.4 % + 20 mV	
(20 to 20) V	20 Hz to 30 kHz (30 to 100) kHz 100 kHz to 1 MHz	0.03 % + 0.4 mV 0.08 % + 2 mV 3.4 % + 0.2 V	
(20 to 200) V	20 Hz to 30 kHz (30 to 100) kHz	0.03 % + 4 mV 0.08 % + 20 mV	
(200 to 1000) V	40 Hz to 10 kHz (10 to 30) kHz	0.02 % + 21 mV 0.15 % + 42 mV	
AC Voltage – Generate			Fluke 5720A
(0 to 2.2) mV	10 Hz to 100 kHz 100 kHz to 1 MHz	0.35 % + 5 µV 1.5 % + 20 µV	
(2.2 to 22) mV	10 Hz to 100 kHz 100 kHz to 1 MHz	0.087 % + 5 µV 0.42 % + 20 µV	
(22 to 220) mV	10 Hz to 100 kHz 100 kHz to 1 MHz	0.063 % + 17 µV 0.34 % + 45 µV	
(0.22 to 2.2) V	10 Hz to 100 kHz 100 kHz to 1 MHz	0.014 % + 30 µV 0.21 % + 300 µV	
(2.2 to 22) V	10 Hz to 100 kHz 100 kHz to 1 MHz	0.013 % + 200 µV 0.19 % + 3.2 mV	
(22 to 220) V	10 Hz to 100 kHz	0.02 % + 2.5 mV	
(220 to 1100) V	10 Hz to 1 kHz	85 µV/V + 3.5 mV	

Parameter/Range	Frequency	Best Uncertainty ^{2,4} (\pm)	Comments
AC Current – Measure			
(0 to 200) μ A	10 Hz to 10 kHz	0.06 % + 20 nA	Fluke 8508A
(0.2 to 2) mA	10 Hz to 10 kHz	0.06 % + 200 nA	
(2 to 20) mA	10 Hz to 10 kHz	0.06 % + 2 μ A	
(20 to 200) mA	10 Hz to 10 kHz	0.06 % + 20 μ A	
(0.2 to 2) A	10 Hz to 10 kHz	0.11 % + 200 μ A	
(2 to 20) A	10 Hz to 10 kHz	0.28 % + 2 mA	
AC Current – Generate			
(9 to 220) μ A	10 Hz to 5 kHz (5 to 10) kHz	0.05 % + 15 nA 0.19 % + 80 nA	Comparison to a multifunction calibrator Fluke 5720A
(0.22 to 2.2) mA	10 Hz to 5 kHz (5 to 10) kHz	0.035 % + 130 nA 0.19 % + 800 nA	
(2.2 to 220) mA	10 Hz to 5 kHz (5 to 10) kHz	0.19 % + 700 nA 0.18 % + 6 μ A	
(22 to 220) mA	10 Hz to 5 kHz (5 to 10) kHz	0.032 % + 4 μ A 0.16 % + 12 μ A	
(0.22 to 2.2) A	20 Hz to 5 kHz (5 to 10) kHz	0.094 % + 100 μ A 0.94 % + 200 μ A	

III. Fluid Quantities

Parameter/Equipment	Range	Best Uncertainty ² (±)	Comments
Flow – Air	(1 to 20) sccm	0.04 sccm	Direct reading mass flowmeter
	(20 to 50) sccm	0.1 sccm	
	(50 to 100) sccm	0.2 sccm	
	(100 to 150) sccm	0.3 sccm	
	(150 to 200) sccm	0.4 sccm	
	(0.2 to 0.5) slm	0.001 slm	
	(0.5 to 1) slm	0.002 slm	
	(1 to 1.5) slm	0.003 slm	
	(1.5 to 2) slm	0.004 slm	
	(2 to 5) slm	0.004 slm	
	(5 to 10) slm	0.02 slm	
	(10 to 15) slm	0.03 slm	
	(15 to 20) slm	0.04 slm	
	(20 to 24) slm	0.05 slm	
	(24 to 32) slm	0.06 slm	
	(32 to 40) slm	0.08 slm	
	(40 to 50) slm	0.1 slm	
	(50 to 60) slm	0.12 slm	
	(60 to 70) slm	0.14 slm	
	(70 to 80) slm	0.16 slm	
	(80 to 90) slm	0.18 slm	
	(90 to 100) slm	0.2 slm	
	(100 to 125) slm	0.25 slm	
	(125 to 150) slm	0.3 slm	
	(150 to 175) slm	0.35 slm	
	(175 to 200) slm	0.4 slm	
	(200 to 225) slm	0.45 slm	
	(225 to 250) slm	0.5 slm	
	(250 to 300) slm	0.6 slm	
	(300 to 400) slm	0.8 slm	
	(400 to 500) slm	1 slm	
	(500 to 600) slm	1.2 slm	
	(600 to 700) slm	1.4 slm	
	(700 to 800) slm	1.6 slm	
(800 to 900) slm	1.8 slm		
(900 to 1000) slm	2 slm		
(40 to 45) scfm	0.47 scfm		
(45 to 50) scfm	0.52 scfm		
(50 to 55) scfm	0.57 scfm		
(55 to 60) scfm	0.62 scfm		
(60 to 65) scfm	0.67 scfm		
(65 to 70) scfm	0.72 scfm		
(70 to 75) scfm	0.77 scfm		
(75 to 80) scfm	0.82 scfm		

IV. Mechanical

Parameter/Equipment	Range	Best Uncertainty ² (±)	Comments
Vacuum – Measure and Measuring Equipment	(Up to 1000) μm Hg	1 % of reading	MKS 660B/627B direct reading vacuum gage
	(1 to 10) mm Hg	0.5 % of reading	MKS 660B/626A direct reading vacuum gage
Direct Verification of Durometer Hardness Verification of Indentor Extension	(0.098 ± 0.002) in	0.0005 in	ASTM D2240 comparison to gage blocks
Verification of the Durometer Spring Force – Round Style	Type A Type B Type E Type O Type C Type D Type DO Type OO Type OOO	1.5 duro points 1.5 duro points 1.5 duro points 1.5 duro points 1.4 duro points 1.4 duro points 1.4 duro points 2.5 duro points 2.5 duro points	Direct reading scale and ASTM Class 3 weights
Quadrant Style	Type A Type B Type E Type O Type C Type D Type DO Type OO Type OOO	3.2 duro points 3.2 duro points 3.2 duro points 3.2 duro points 3.2 duro points 3.2 duro points 3.2 duro points 3.8 duro points 3.8 duro points	Top loading scales and ASTM class 3 weights

Parameter/Equipment	Range	Best Uncertainty ² (±)	Comments
Scales and Balances	5 mg to 50 g (50 to 100) g (100 to 200) g (200 to 500) g 500 g to 1 kg (1 to 5) kg (5 to 10) kg (10 to 15) kg (15 to 20) kg (0.5 to 5) lb (5 to 50) lb (50 to 100) lb (100 to 500) lb (500 to 1000) lb (1000 to 2000) lb (2000 to 2500) lb	15 mg 16 mg 18 mg 30 mg 53 mg 260 mg 510 mg 760 mg 1 g 5.3×10^{-4} lb (240 mg) 5.3×10^{-3} lb (2.4 g) 0.011 lb (4.7 g) 0.051 lb (23 g) 0.11 lb (47 g) 0.21 lb (93 g) 0.27 lb (120 g)	ASTM E617 class 3 weights NIST handbook 105-1 class F weights
Pressure – Measure and Measuring Equipment Pneumatic and Hydraulic	(13.8 to 17.2) kPa (17.2 to 24.1) kPa (24.1 to 37.9) kPa (37.9 to 63.5) kPa (63.5 to 93.1) kPa (93.1 to 162) kPa (162 to 300) kPa (300 to 575) kPa (575 to 850) kPa (850 to 1540) kPa (1.54 to 2.2) MPa (2.2 to 2.9) MPa (2.9 to 3.6) MPa (3.6 to 3.9) MPa (3.9 to 5) MPa (5 to 6.4) MPa (6.4 to 7) MPa	1.4 Pa 1.4 Pa 2.1 Pa 2.8 Pa 4.2 Pa 6.9 Pa 14 Pa 28 Pa 40 Pa 69 Pa 69 Pa 140 Pa 140 Pa 210 Pa 210 Pa 280 Pa 280 Pa	2465 Piston gauge

Parameter/Equipment	Range	Best Uncertainty ² (±)	Comments
Pressure – Measure and Measuring Equipment (cont)			
Hydraulic Only	(7 to 14) MPa (14 to 21) MPa (21 to 28) MPa (28 to 35) MPa (35 to 42) MPa (42 to 49) MPa (49 to 56) MPa (56 to 63) MPa (63 to 70) MPa (70 to 77) MPa (77 to 84) MPa (84 to 91) MPa (91 to 98) MPa (98 to 104) MPa (104 to 110) MPa	410 Pa 650 Pa 870 Pa 1.1 kPa 1.3 kPa 1.5 kPa 1.7 kPa 1.9 kPa 2.1 kPa 2.4 kPa 2.6 kPa 2.8 kPa 3 kPa 3.1 kPa 3.3 kPa	DHI PG7302
Torque –			
Counter Clockwise	(1.25 to 4) lbf·in (4 to 8) lbf·in (8 to 12) lbf·in (12 to 16) lbf·in (16 to 20) lbf·in	0.1 lbf·in 0.1 lbf·in 0.13 lbf·in 0.14 lbf·in 0.16 lbf·in	AKO torque stand and torque load cells 20 lbf·in torque cell
Clockwise	(1.25 to 4) lbf·in (4 to 8) lbf·in (8 to 12) lbf·in (12 to 16) lbf·in (16 to 20) lbf·in	0.05 lbf·in 0.07 lbf·in 0.09 lbf·in 0.11 lbf·in 0.13 lbf·in	20 lbf·in torque cell

Parameter/Equipment	Range	Best Uncertainty ² (±)	Comments
Torque – (cont)			AKO torque stand and torque load cells
Clockwise	(20 to 40) lbf·in	0.21 lbf·in	120 lbf·in torque cell
	(40 to 60) lbf·in	0.49 lbf·in	
	(60 to 80) lbf·in	0.65 lbf·in	
	(80 to 100) lbf·in	0.81 lbf·in	
	(100 to 120) lbf·in	0.97 lbf·in	
	(10 to 20) lbf·ft	0.16 lbf·ft	100 lbf·ft torque cell
	(20 to 40) lbf·ft	0.32 lbf·ft	
	(40 to 60) lbf·ft	0.49 lbf·ft	
	(60 to 80) lbf·ft	0.65 lbf·ft	
	(80 to 100) lbf·ft	0.81 lbf·ft	
	(100 to 120) lbf·ft	0.97 lbf·ft	300 lbf·ft torque cell
	(120 to 180) lbf·ft	1.5 lbf·ft	
	(180 to 240) lbf·ft	2 lbf·ft	
	(240 to 300) lbf·ft	2.5 lbf·ft	
	(300 to 400) lbf·ft	3.3 lbf·ft	1000 lbf·ft torque cell
	(400 to 600) lbf·ft	4.9 lbf·ft	
(600 to 800) lbf·ft	6.5 lbf·ft		
(800 to 1000) lbf·ft	8.1 lbf·ft		
(1000 to 1600) lbf·ft	13 lbf·ft	4000 lbf·ft torque cell	
(2000 to 2400) lbf·ft	20 lbf·ft		
(2500 to 3200) lbf·ft	26 lbf·ft		
(3200 to 4000) lbf·ft	33 lbf·ft		
(4000 to 5200) lbf·ft	42 lbf·ft	6500 lbf·ft torque cell	
(5200 to 6500) lbf·ft	53 lbf·ft		
(6500 to 8000) lbf·ft	95 lbf·ft	20 000 lbf·ft torque cell	
(8000 to 12 000) lbf·ft	150 lbf·ft		
(12 000 to 16 000) lbf·ft	190 lbf·ft		
(16 000 to 20 000) lbf·ft	240 lbf·ft		

V. Thermodynamics

Parameter/Equipment	Range	Best Uncertainty ² (±)	Comments
Temperature – Measure	(-20 to 0) °C (0 to 300) °C (300 to 500) °C (500 to 550) °C	0.01 °C 0.02 °C 0.03 °C 0.03 °C	Circulating bath/SPRT

VI. Time and Frequency

Parameter/Equipment	Range	Best Uncertainty ² (±)	Comments
Stopwatches	Up to 7 hrs and 59 min	0.056 s	WWV receiver/frequency counter (time interval)
Frequency – Measuring Equipment	1 µHz to 100 kHz 100 kHz to 60 MHz	0.12 mHz 70 mHz	WWV receiver/synthesizer
Frequency – Measure	1 µHz to 1 Hz 1 Hz to 100 kHz 100 kHz to 1 MHz (1 to 100) MHz (100 to 225) MHz	1.2 nHz 1.2 µHz 1.2 mHz 0.1 Hz 0.1 Hz	WWV receiver/counter

¹ This laboratory offers commercial calibration service.

² “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 and to influences from the circumstances of the specific calibration.

³ In the statement of best uncertainty, L is the numerical value of the nominal length of the device measured in inches and R is the value of the resolution of the device in microinches.

⁴ The measurands stated are generated with the Fluke 8508A, 5720A, & 5500A series of instruments. This capability is suitable for the calibration of the devices intended to measure the stated measurand in the ranges indicated. Best measurement uncertainties are expressed as either a specific value that covers the full range or as a fraction or percentage of the reading plus a fixed floor specification.