The American Association for Laboratory Accreditation

World Class Accreditation

Accredited Laboratory

A2LA has accredited

HJM PRECISION, INC.

Troy, 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 8 January 2009*).

Presented this 31st day of August 2009.

President & CEO
For the Accreditation Council
Certificate Number 1579.01
Valid to September 30, 2011

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

HJM PRECISION, INC.
9 New Turnpike Road
Troy, NY 12182
Michael J. Magee Phone: 518 235 7407

CALIBRATION

Valid To: September 30, 2011 Certificate Number: 1579.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations and dimensional inspections[1]:

I. Dimensional

Parameter/Equipment	Range	Best Uncertainty[2, 4] (±)	Comments
Calipers[3]	(0 to 24) in (24 to 96) in	(200 + 1*L*) µin (250 + 3*L*) µin	Gage blocks Length standards
Analog/Digital Indicators[3] – Plunger Lever Bore Depth	 Up to 4 in Up to 4 in Up to 12 in Up to 12 in	 100 µin 100 µin 200 µin 210 µin	Precision micrometer head/ gage blocks
Gage Blocks – Length only Steel Other Materials	 (0.005 to 4) in (0.005 to 4) in	 (3.5 + 4*L*) µin (4 + 4.5*L*) µin	Gage block comparator

Parameter/Equipment	Range	Best Uncertainty[2, 4] (±)	Comments
Length Standards	(0 to 80) in	(30 + 3L) µin	Master length standards/ comparator
Micrometers[3] –			
Outside Diameter	(0 to 96) in	(200 + 2L) µin	Gage blocks
Bore	(0 to 8) in	(100 + 1L) µin	Master ring gage
Depth	(0 to 12) in	(200 + 1L) µin	Gage blocks
Micrometers, Inside Diameter	(0 to 12) in ≥ 12 in	(20 + 4L) µin (100 + 2L) µin	Length standards
Optical Comparators[3] –			
Linearity Squareness	Up to 48 in	200 µin	Gage blocks / length standards
Pipe Thread Plug –			
Pitch Diameter	(0.0625 to 8) in	(200 + 1.5D) µin	Three wire method in fixture
Major Diameter	(0.0625 to 8) in	(200 + 1D) µin	Comparator
Length to Notch	(0.0625 to 8) in	300 µin	Gage blocks
Pipe Thread Ring –			
Standoff	(0.0625 to 3) in	350 µin	Master set plug
Thickness	(0.0625 to 3) in	25 µin	Comparator
Plain Plug Gages, Cylindrical	(0 to 12) in	(19 + 5D) µin	Comparator or laser micrometer
Plain Ring Gages, Cylindrical	(0 to 12) in	(20 + 5D) µin	Comparator

Parameter/Equipment	Range	Best Uncertainty[2, 4] (±)	Comments
Surface Plates[3] –			
Flatness	Up to (3 × 4) ft Up to (8 × 14) ft	(100 + 1.5*L*) µin (60 + 0.75*L*) µin	Planekator or Optodyne Laser Note: Uncertainty is to be no less than the acceptable closure error for the procedure.
Thread Plug Gages –			
Pitch Diameter	(0.06 to 4) in (4 to 8) in	50 µin (40 + 3*D*) µin	Three wire method & Universal Measuring Machine (UMM)
Major Diameter	(0.06 to 8) in	(20 + 4*D*) µin	UMM
Thread Ring Gages –			
Adjustable Gages Pitch Diameter Minor Diameter	 Up to 1.5 in (1.5 to 8) in	 300 µin (200 + *D*) µin	 Master set plug & UMM
Solid Gages Pitch Diameter Minor Diameter	 (0.25 to 8) in (0.25 to 8) in	 (200 + *D*) µin (200 + *D*) µin	 UMM
Video Measurement System[3] –			
X, Y Axis Z Axis	Up to 48 in Up to 12 in	200 µin 400 µin	Gage blocks with length standards
Vision Measurement System[3] –			
X, Y Axis	Up to 24 in Up to 48 in	50 µin 100 µin	Gage blocks with length standards
Z Axis	Up to 12 in	100 µin	

Parameter/Equipment	Range	Best Uncertainty[2, 4] (±)	Comments
Height Gages[3]	(0 to 48) in	(200 + *L*) µin	Gage blocks
Torque Calibrators	Up to 200 in·oz Up to 100 in·lbs Up to 250 ft·lbs Up to 2000 ft·lbs	0.2 in·oz 0.4 in·lbs 0.8 in·lbs 1.6 ft·lbs	Precision weights, arms and trays

II. Dimensional Testing

Parameter/Equipment	Range	Best Uncertainty[2, 4] (±)	Comments
Length	Up to 80 in	(100 + 2*L*) µin	Linear comparator, vision system, or surface plate metrology

III. Electrical

Parameter/Equipment	Range	Best Uncertainty[2, 5] (±)	Comments
DC Voltage[3] – Generate	(0 to 220) mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V	18 µV/V + 0.6 µV 11 µV/V + 1.0 µV 11 µV/V + 3.5 µV 9 µV/V + 6.5 µV 12 µV/V + 80 µV 13 µV/V + 500 µV	Fluke 5700A Series II
DC Current[3] – Generate	(0 to 220) µA 220 µA to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A (2.2 to 11) A	73 µA/A + 8 nA 70 µA/A + 8 nA 72 µA/A + 80 nA 78 µA/A + 0.8 µA 0.012 % + 25 µA 0.11 % + 330 µA	Fluke 5700A Series II Fluke 5500A

Parameter/Equipment	Range	Best Uncertainty[2, 5] (±)	Comments
DC Voltage[3] – Measure	(0 to 200) mV 200 mV to 2 V (2 to 20) V (20 to 200) V (200 to 1100) V	76 µV/V + 1.8 µV 19 µV/V + 1.8 µV 17 µV/V + 3 µV 32 µV/V + 400 µV 33 µV/V + 440 µV	Keithley 2002
AC/DC High Voltage[3] – Measure	(1 to 100) kV	3 % of rdg + 760 V	High Voltage DVR-150 Tektronix TDS-3012B
DC Current[3] – Measure	(0 to 200) µA (200 to 2000) µA (2 to 20) mA (20 to 200) mA (200 to 2000) mA	0.12 % of rdg + 5 nA 0.047 % of rdg + 40 nA 0.046 % of rdg + 400 nA 0.051 % of rdg + 4 µA 0.099 % of rdg + 40 µA	Keithley 2002
	(2 to 5) A (5 to 10) A	0.72 % of rdg + 1 mA 0.71 % of rdg + 2 mA	Fluke 89 IV
Resistance[3] – Generate			
Fixed Point	0 Ω 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1000 Ω 1900 Ω 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1000 kΩ 1900 kΩ 10 MΩ 19 MΩ 100 MΩ	30 µΩ/Ω + 95 µΩ 30 µΩ/Ω + 95 µΩ 30 µΩ/Ω + 95 µΩ 30 µΩ/Ω + 95 µΩ 30 µΩ/Ω + 95 µΩ 30 µΩ/Ω + 95 µΩ 30 µΩ/Ω + 95 µΩ 30 µΩ/Ω + 95 µΩ 87 µΩ/Ω + 20 µΩ 87 µΩ/Ω + 20 µΩ 87 µΩ/Ω + 20 µΩ 87 µΩ/Ω + 20 µΩ 87 µΩ/Ω + 20 µΩ 87 µΩ/Ω + 20 µΩ 82 µΩ/Ω + 110 µΩ 82 µΩ/Ω + 110 µΩ 82 µΩ/Ω + 110 µΩ 82 µΩ/Ω + 110 µΩ	Fluke 5700A Series II

Parameter/Equipment	Range	Best Uncertainty[2, 5] (±)	Comments
Resistance[3] – Generate (cont.) Variable Point	 (0 to 11) Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω (330 to 1100) 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 to 1100) kΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ	 0.027 % + 8 mΩ 0.016 % + 15 mΩ 0.013 % + 15 mΩ 0.013 % + 15 mΩ 0.013 % + 60 mΩ 0.014 % + 60 mΩ 0.014 % + 600 mΩ 0.014 % + 600 mΩ 0.017 % + 6 Ω 0.016 % + 6 Ω 0.020 % + 55 Ω 0.021 % + 55 Ω 0.12 % + 550 Ω 0.13 % + 550 Ω 0.63 % + 5.5 kΩ 0.63 % + 17 kΩ	 Fluke 5500A
Resistance[3] – Measure	(0 to 20) Ω (20 to 200) Ω (200 to 2000) Ω (2 to 20) kΩ (20 to 200) kΩ (200 to 2000) kΩ (2 to 20) MΩ (20 to 200) MΩ (200 to 1000) MΩ	0.059 % of rdg + 120 μΩ 36 μΩ/Ω + 0.8 μΩ 20 μΩ/Ω + 0.8 μΩ 20 μΩ/Ω + 8 μΩ 35 μΩ/Ω + 180 mΩ 77 μΩ/Ω + 1 Ω 0.034 % of rdg + 12 Ω 0.075 % of rdg + 600 Ω 0.25 % of rdg + 15 kΩ	Keithley 2002
Capacitance[3] – Generate	(0.33 to 0.5) nF (0.5 to 1.1) nF (1.1 to 3.3) nF (3.3 to 11) nF (11 to 33) nF (33 to 110) nF (110 to 330) nF (330 to 1100) nF (1.1 to 3.3) μF (3.3 to 11) μF (11 to 33) μF (33 to 110) μF (110 to 330) μF (330 to 1100) μF	1.6 % + 10 pF 2.1 % + 10 pF 1.8 % + 10 pF 2.1 % + 10 pF 1.6 % + 100 pF 0.51 % + 100 pF 0.47 % + 300 pF 2 % + 1 nF 1.6 % + 3 nF 2 % + 10 nF 1.7 % + 30 nF 0.98 % + 100 nF 1.2 % + 300 nF 1.5 % + 300 nF	Fluke 5500A

Parameter/Equipment	Range	Best Uncertainty[2, 6] (±)	Comments
Oscilloscope[3] –			
Bandwidth	100 mHz to 100 MHz (100 to 550) MHz 550 MHz to 1.1 GHz	2.1 % 3.6 % 4.8 %	Wavetek 9500
Vertical Deflection –			
DC Level – 50 Ω 1 MΩ	 (-5.56 to 5.56) V (-222.4 to 5.56) V	 0.03 % + 25 μV 0.08 % + 25 mV	
Square Wave – 50 Ω / 1 MΩ	 (35.52 to 1000) μVpp (1 to 21) mVpp (21 to 556) mVpp 556 mV to 210 V	 1.2 % + 10 μV 0.32 % + 15 μV 0.12 % + 1 μV 0.09 % + 1 mV	
Time Marker –			
Square Wave Pulse / Triangle	450.5 ps to 55.00 s (900.91 to 55.00) s	16 μs/s + 0.001 ns 16 μs/s + 0.001 ns	

Parameter/Range	Frequency	Best Uncertainty[2] (±)	Comments
AC Voltage[3] – Measure			
(0 to 200) mV	(50 to 100) Hz (100 to 2000) Hz	0.19 % of rdg + 30 μV 0.12 % of rdg + 20 μV	Keithley 2002
200 mV to 2 V	(50 to 100) Hz (100 to 2000) Hz	0.089 % of rdg + 300 μV 0.031 % of rdg + 200 μV	
(2 to 20) V	(50 to 100) Hz (100 to 2000) Hz	0.088 % of rdg + 3 mV 0.042 % of rdg + 3 mV	
(20 to 200) V	(50 to 100) Hz (100 to 2000) Hz	0.089 % of rdg + 30 mV 0.043 % of rdg + 30 mV	
(200 to 750) V	(50 to 100) Hz (100 to 2000) Hz	0.13 % of rdg + 113 mV 0.067 % of rdg + 113 mV	

Parameter/Range	Frequency	Best Uncertainty[2, 5] (±)	Comments
AC Voltage[3] – Generate			
(10 to 2.2) mV	40 Hz to 20 kHz	0.55 % + 5 µV	Fluke 5700A Series II
(2.2 to 22) mV	40 Hz to 20 kHz	0.054 % + 5 µV	
(22 to 220) mV	40 Hz to 20 kHz	0.016 % + 8 µV	
220 mV to 2.2 V	40 Hz to 20 kHz	0.013 % + 6 µV	
(2.2 to 22) V	40 Hz to 20 kHz	0.011 % + 60 µV	
(22 to 220) V	40 Hz to 20 kHz	0.013 % + 0.8 mV	
(220 to 1100) V	(50 to 1000) Hz	0.014 % + 3.5 mV	
AC Current[3] – Generate			
(9 to 220) µA	(40 to 1000) Hz	0.024 % + 16 nA	Fluke 5700A Series II
220 µA to 2.2 mA	(40 to 1000) Hz	0.023 % + 35 nA	
(2.2 to 22) mA	(40 to 1000) Hz	0.023 % + 350 nA	
(22 to 220) mA	(40 to 1000) Hz	0.023 % + 3.5 µA	
220 mA to 2.2 A	(20 to 1000) Hz	0.084 % + 35 µA	
(2.2 to 11) A	(45 to 65) Hz	0.14 % + 2 mA	Fluke 5500A
	(65 to 500) Hz	0.17 % + 2 mA	
	(500 to 1000) Hz	0.43 % + 2 mA	
AC Current[3] – Measure			
(0 to 200) µA	(50 to 200) Hz	0.29 % of rdg + 30 nA	Keithley 2002
	(200 to 1000) Hz	0.53 % of rdg + 30 nA	
(200 to 2000) µA	(50 to 200) Hz	0.2 % of rdg + 300 nA	
	(200 to 1000) Hz	0.18 % of rdg + 300 nA	
(2 to 20) mA	(50 to 200) Hz	0.2 % of rdg + 3 µA	
	(200 to 1000) Hz	0.17 % of rdg + 3 µA	
(20 to 200) mA	(50 to 200) Hz	0.2 % of rdg + 30 µA	
	(200 to 1000) Hz	0.17 % of rdg + 30 µA	
(200 to 2000) mA	(50 to 200) Hz	0.22 % of rdg + 300 µA	
	(200 to 1000) Hz	0.39 % of rdg + 300 µA	
(2 to 5) A	(20 to 1000) Hz	0.24 % of rdg + 2 mA	Fluke 89 IV
(5 to 10) A	(20 to 1000) Hz	0.23 % of rdg + 2 mA	

IV. Mechanical

Parameter/Equipment	Range	Best Uncertainty[2] (±)	Comments
Balances[3]	Up to 1000 g Up to 5000 g Up to 10 000 g Up to 15 000 g Up to 20 000 g	0.8 mg 6.2 mg 6.5 mg 24 mg 24 mg	Class 1 & 3 weights
Scales[3]	Up to 50 lb Up to 200 lb Up to 400lb Up to 600 lb Up to 800 lb Up to 1000 lb	0.002 lb 0.023 lb 0.24 lb 0.7 lb 1.2 lb 1.1 lb	Class 6 weights
Force Gages[3]	(0 to 50) lbf (50 to 500) lbf (500 to 10 000) lbf (10 000 to 30 000) lbf	0.1 lbf 1 % of rdg 1 % of rdg 1 % of rdg	Class 1, 3 and 6 weights and load cells
Torque Wrenches	10 in·oz to 2000 ft·lb	1 % of rdg	Torque calibrator
Vacuum[3]	(-15 to 0) PSI	0.013 PSI	Beta 320
Pressure	0 to 12 in·$H_2$0 Up to 500 PSI Up to 8000 PSI Up to 16 000 PSI	0.042 in·$H_2$0 0.14 PSI 1.5 PSI 2.8 PSI	Dwyer 1425 Pressurements M2800/3
Pressure[3]	Up to 5 PSI Up to 50 PSI Up to 200 PSI Up to 600 PSI Up to 800 PSI Up to 1000 PSI Up to 3000 PSI Up to 5000 PSI	0.004 PSI 0.035 PSI 0.15 PSI 0.42 PSI 0.65 PSI 0.8 PSI 2.4 PSI 3.5 PSI	Unomat MCX-II

V. Thermodynamics

Parameter/Equipment	Range	Best Uncertainty[2] (±)	Comments
Relative Humidity[3] – Measure			
At Ambient	(10 to 90) % RH (90 to 97) % RH	2.2 % RH 3.4 % RH	Vaisala HM141, HMP46
Relative Humidity[3] – Measuring Equipment			
At Ambient	11 % RH 33 % RH 75 % RH 97 % RH	1.6 % RH 1.5 % RH 1.8 % RH 2.5 % RH	Reference salts
Thermometers[3] – Measuring Equipment	-5 °C to 700 °C	0.4 °C	Hart 7102, Fluke 9173, Unomat MCX-II
Electrical Cal of RTD / Thermocouples[3] – Generate & Measure			
PT100 – Generate PT100 – Measure J K T E 	-200 °C to 850 °C -200 °C to 850 °C -210 °C 1200 °C -270 °C to -200 °C -200 °C to 1372 °C -270 °C to -180 °C -180 °C to -75 °C -75 °C to 400 °C -270 °C to -150 °C -150 °C to 1000 °C	0.16 °C 0.2 °C 0.14 °C 0.36 °C 0.14 °C 0.59 °C 0.24 °C 0.13 °C 0.36 °C 0.14 °C	Druck Unomat MCX-II or Fluke 5500

VI. Time & Frequency

Parameter/Range	Frequency	Best Uncertainty[2, 7] (±)	Comments
Frequency[3] – Generate			
Sine Wave Square Wave Triangular Wave	100 µHz to 15 MHz 100 µHz to 15 MHz 100 µHz to 100 kHz	0.26 % 0.26 % 0.26 %	Agilent 33120A

Parameter/Range	Frequency	Best Uncertainty[2, 7] (±)	Comments
Frequency[3] – Measure	0.1 Hz to 1 MHz (1 to 100) MHz (100 to 225) MHz	27 µHz/Hz 6.2 µHz/Hz 13 µHz/Hz	Agilent 53132A

[1] This laboratory offers commercial and field 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, to the environment 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 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.

[4] In the statement of best uncertainty, L is the numerical value of the nominal length of the device measured in inches; D is the numerical value of the nominal diameter of the device measured in inches.

[5] The measurands stated are generated with the Fluke 5500A, Fluke 5700A, and Fluke 89 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. .

[6] The measurands stated are generated with the Wavetek 9500. This capability is suitable for the calibration of the devices intended to measure the stated measurand in the ranges indicated. Best measurement uncertainty is read as output plus one-year floor specifications where defined.

[7] Agilent 33120A and Agilent 53132A best uncertainty is read as reading plus or percent of range.