



World Class Accreditation

The American Association for Laboratory 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.



A handwritten signature in black ink, appearing to read "Peter Abney".

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 inspections¹:

I. Dimensional

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Calipers ³	(0 to 24) in (24 to 96) in	(200 + 1L) µin (250 + 3L) 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 + 4L) µin (4 + 4.5L) µin	Gage block comparator

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

Parameter/Equipment	Range	CMC ^{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/Calibration⁷

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Length	Up to 80 in	(100 + 2L) μin	Linear comparator, vision system, or surface plate metrology

III. Electrical – DC / Low Frequency

Parameter/Equipment	Range	CMC ^{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	CMC ^{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 (2 to 5) A (5 to 10) A	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 0.72 % of rdg + 1 mA 0.71 % of rdg + 2 mA	Keithley 2002 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	CMC ^{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	CMC ^{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	(-5.56 to 5.56) V	0.03 % + 25 μV	
1 MΩ	(-222.4 to 5.56) V	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	CMC 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	CMC ^{2,5} (±)	Comments
AC Voltage ³ – Generate (10 to 2.2) mV (2.2 to 22) mV (22 to 220) mV 220 mV to 2.2 V (2.2 to 22) V (22 to 220) V (220 to 1100) V	 40 Hz to 20 kHz 40 Hz to 20 kHz 40 Hz to 20 kHz 40 Hz to 20 kHz 40 Hz to 20 kHz 40 Hz to 20 kHz (50 to 1000) Hz	 0.55 % + 5 μV 0.054 % + 5 μV 0.016 % + 8 μV 0.013 % + 6 μV 0.011 % + 60 μV 0.013 % + 0.8 mV 0.014 % + 3.5 mV	 Fluke 5700A Series II
AC Current ³ – Generate (9 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	 (40 to 1000) Hz (40 to 1000) Hz (40 to 1000) Hz (40 to 1000) Hz (20 to 1000) Hz (45 to 65) Hz (65 to 500) Hz (500 to 1000) Hz	 0.024 % + 16 nA 0.023 % + 35 nA 0.023 % + 350 nA 0.023 % + 3.5 μA 0.084 % + 35 μA 0.14 % + 2 mA 0.17 % + 2 mA 0.43 % + 2 mA	 Fluke 5700A Series II Fluke 5500A
AC Current ³ – Measure (0 to 200) μA (200 to 2000) μA (2 to 20) mA (20 to 200) mA (200 to 2000) mA (2 to 5) A (5 to 10) A	 (50 to 200) Hz (200 to 1000) Hz (50 to 200) Hz (200 to 1000) Hz (50 to 200) Hz (200 to 1000) Hz (50 to 200) Hz (200 to 1000) Hz (20 to 1000) Hz (20 to 1000) Hz	 0.29 % of rdg + 30 nA 0.53 % of rdg + 30 nA 0.2 % of rdg + 300 nA 0.18 % of rdg + 300 nA 0.2 % of rdg + 3 μA 0.17 % of rdg + 3 μA 0.2 % of rdg + 30 μA 0.17 % of rdg + 30 μA 0.22 % of rdg + 300 μA 0.39 % of rdg + 300 μA 0.24 % of rdg + 2 mA 0.23 % of rdg + 2 mA	 Keithley 2002 Fluke 89 IV

IV. Mechanical

Parameter/Equipment	Range	CMC 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 O Up to 500 psi Up to 8000 psi Up to 16 000 psi	0.042 in·H ₂ O 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	CMC 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 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 to 850) °C (-200 to 850) °C (-210 to 1200) °C (-270 to -200) °C (-200 to 1372) °C (-270 to -180) °C (-180 to -75) °C (-75 to 400) °C (-270 to -150) °C (-150 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	CMC ² (±)	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 % of rdg 0.26 % of rdg 0.26 % of rdg	Agilent 33120A
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 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.

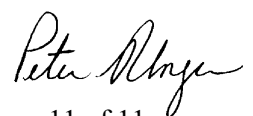
³ Field calibration service is available for this calibration and this laboratory meets A2LA R104 – *General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for these calibrations. Please note the actual measurement uncertainties achievable on a customer's site can normally 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; 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. CMCs 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. CMCs are read as a percentage of output plus one-year floor specifications where defined.

⁷ This laboratory meets R205 – *Specific Requirements: Calibration Laboratory Accreditation Program* for the types of dimensional calibrations listed above. Accredited test reports issued containing appropriate statements of measurement results, measurement uncertainty, and traceability are considered equivalent to a “calibration” certificate.





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