



PERRY JOHNSON LABORATORY ACCREDITATION, INC.

Certificate of Accreditation

Perry Johnson Laboratory Accreditation, Inc. has assessed the Laboratory of:

Mid-South Calibration

6047 Executive Centre Drive, Suite 1, Memphis, TN 38134

*(Hereinafter called the Organization) and hereby declares that Organization is accredited
in accordance with the recognized International Standard:*

ISO/IEC 17025:2005

This accreditation demonstrates technical competence for a defined scope and the
operation of a laboratory quality management system
(as outlined by the joint ISO-ILAC-IAF Communiqué dated January 2009):

***Calibration of Dimensional, Electrical, Mechanical, Thermodynamics, Mass,
Force & Weighing Devices, and Time & Frequency Instruments***
(As detailed in the supplement)

Accreditation claims for such testing and/or calibration services shall only be made from addresses referenced within this certificate. This Accreditation is granted subject to the system rules governing the Accreditation referred to above, and the Organization hereby covenants with the Accreditation body's duty to observe and comply with the said rules.

For PJLA:

Tracy Szerszen
President/Operations Manager

Perry Johnson Laboratory
Accreditation, Inc. (PJLA)
755 W. Big Beaver, Suite 1325
Troy, Michigan 48084

Initial Accreditation Date:

July 15, 2003

Issue Date:

May 18, 2016

Expiration Date:

May 18, 2018

Accreditation No.:

59185

Certificate No.:

L16-203

*The validity of this certificate is maintained through ongoing assessments based on a continuous
accreditation cycle. The validity of this certificate should be
confirmed through the PJLA website: www.pjllabs.com*



Certificate of Accreditation: Supplement

Mid-South Calibration

6047 Executive Centre Drive, Suite 1, Memphis, TN 38134

Contact Name: Will Page Phone: 901-509-3174

Accreditation is granted to the facility to perform the following calibrations:

Mechanical

MEASURED INSTRUMENT, QUANTITY OR GAUGE	RANGE OR NOMINAL DEVICE SIZE AS APPROPRIATE	CALIBRATION AND MEASUREMENT CAPABILITY EXPRESSED AS AN UNCERTAINTY (\pm)	CALIBRATION EQUIPMENT AND REFERENCE STANDARDS USED
Positive Pressure Oil Free ^F	15 psi to 1 000 psi	0.6 psi	Fluke 700P08 w/ Fluke 702
Pressure Oil ^{FO}	50 psi to 5 000 psi	13 psi	Ashcroft 1305D
Pressure ^{FO}	5 100 psi to 20 000 psi	120 psi	Wika 332.30
Vacuum ^F	0.87 psi to -14.5 psi	0.05 psi	Dama MPS28
	35 mbar to 1 355 mbar	0.28 mbar	Druck ADTS403
Torque Wrench ^F	5 lbf·in to 50 lbf·in	5 % of Reading + 0.1 lbf·in	Armstrong 64-622
	100 lbf·in to 1 000 lbf·in	0.75 % of Reading + 1.2 lbf·in	CDI 10002-1-ETT
	60 lbf·in to 600 lbf·in	0.75 % of Reading + 1 lbf·in	CDI 6004-F-ETT

Mass, Force, and Weighing Devices

MEASURED INSTRUMENT, QUANTITY OR GAUGE	RANGE OR NOMINAL DEVICE SIZE AS APPROPRIATE	CALIBRATION AND MEASUREMENT CAPABILITY EXPRESSED AS AN UNCERTAINTY (\pm)	CALIBRATION EQUIPMENT AND REFERENCE STANDARDS USED
Force Gages Compression ^{FO}	200 lb to 10 000 lb	0.29 % of Reading + 17.38 lb	Omega LC1001-10K W/ DP41-S
	10 000 lb to 50 000 lb	0.29 % of Reading + 74.78 lb	Omega LC1001-50K W/ DP41-S
Weight Measure ^F	1 g	0.000 11 g	Troemner Class 1 Weights
	2 g	0.000 88 g	
	5 g	0.000 92 g	
	10 g	0.000 98 g	
	20 g	0.001 1 g	
	50 g	0.001 4 g	
	100 g	0.002 2 g	
	200 g	0.004 1 g	
	500 g	0.053 g	
	1 kg	0.050 g	
	2 kg	0.055 g	
	1 lb	0.081 lb	Class F Weight Set
	5 lb	0.088 lb	
	20 lb	0.076 lb	
	50 lb	0.078 lb	



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Bench Scales ^{FO}	1 g to 2 000 g Res= 0.01 g	$(1.16 \times 10^{-2} + 1.3 \times 10^{-6} \text{Wt}) \text{ g}$	Troemner Class 1 Weights
	0.002 lb to 1 lb Res= 0.000 1 lb	$(2 \times 10^{-4} + 9.29 \times 10^{-5} \text{Wt}) \text{ lb}$	Class F Weights
Bench Scales, Floor Scales ^{FO}	1.0 lb to 500 lb Res= 0.005 lb	$(5.8 \times 10^{-3} + 9.79 \times 10^{-5} \text{Wt}) \text{ lb}$	Class F Weights

Time and Frequency

MEASURED INSTRUMENT, QUANTITY OR GAUGE	RANGE OR NOMINAL DEVICE SIZE AS APPROPRIATE	CALIBRATION AND MEASUREMENT CAPABILITY EXPRESSED AS AN UNCERTAINTY (\pm)	CALIBRATION EQUIPMENT AND REFERENCE STANDARDS USED
Frequency Measure ^F	0.9 Hz to 10 kHz	0.3 Hz	Fluke 5500A- SC300
	10 kHz to 2 MHz	5.7 Hz	
	2 MHz to 200 MHz	41 Hz	HP 8660C W/ HP 86603A
	10 ns to 100 s	0.2 ns	HP5335A
	200 MHz to 18 GHz	0.25 kHz	HP5342

Thermodynamic

MEASURED INSTRUMENT, QUANTITY OR GAUGE	RANGE OR NOMINAL DEVICE SIZE AS APPROPRIATE	CALIBRATION AND MEASUREMENT CAPABILITY EXPRESSED AS AN UNCERTAINTY (\pm)	CALIBRATION EQUIPMENT AND REFERENCE STANDARDS USED
Equipment to Measure Humidity ^{FO}	5 % RH to 95 % RH	4 % RH	Control 4085 and Humidity Chamber

Dimensional

MEASURED INSTRUMENT, QUANTITY OR GAUGE	RANGE OR NOMINAL DEVICE SIZE AS APPROPRIATE	CALIBRATION AND MEASUREMENT CAPABILITY EXPRESSED AS AN UNCERTAINTY (\pm)	CALIBRATION EQUIPMENT AND REFERENCE STANDARDS USED
Micrometers OD ^{FO}	0.05 in to 1 in	$(120 + 4.2\text{L}) \mu\text{in}$	Mitutoyo FSI Block Set, Mitutoyo Long Blocks
	1 in to 6 in	$(220 + 4.2\text{L}) \mu\text{in}$	
	6 in to 12 in	$(270 + 20\text{L}) \mu\text{in}$	
	12 in to 18 in	$(280 + 20\text{L}) \mu\text{in}$	
	18 in to 24 in	$(300 + 20\text{L}) \mu\text{in}$	
	24 in to 30 in	$(310 + 20\text{L}) \mu\text{in}$	
Micrometers Depth ^{FO}	0.05 in to 6 in	$(220 + 20\text{L}) \mu\text{in}$	Mitutoyo FSI Block Set, Surface Plate
	0.05 in to 30 in	$(250 + 20\text{L}) \mu\text{in}$	



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Calipers Vernier, Dial, Digital ^{FO}	6 in to 12 in	(600 + 20L) μ in	Mitutoyo FSI Block Set, Surface Plate
	12 in to 24 in	(900 + 20L) μ in	
Height Gauges ^{FO}	0.5 in to 30 in	(100 + 20L) μ in	
Steel Rules and Tape Measures ^{FO}	0.01 in to 72 in	(0.016 + 250L) μ in	Mitutoyo FSI Block Set, Mitutoyo Long Blocks
Indicator Plunger Type ^{FO}	1 in to 6 in	(100 + 20L) μ in	Mitutoyo FSI Block Set
Indicator Quill Type ^{FO}	0.05 in to 1 in	(40 + 20L) μ in	
Surface Plates Repeatability ^{FO}	12 in to 98 in	50 μ in	Repeat-O-Meter + STARRETT 715
Surface Plate (flatness) ^{FO}	24 in to 98 in	(56 + 0.72D) μ in	Rahn 36in Planekator
Gage Blocks ^F	0.05 in to 4 in	(3 + 2L) μ in	Federal 130B-16 with Mitutoyo FS1 Block Set
Gage Pins ^F	0.04 in to 2 in	30.57 μ in	Mitutoyo LSM-9602 Laser Micrometer
Angle Blocks ^F	5° to 90°	0.15°	Mitutoyo Profile Projector
Levels ^{FO}	0.1° to 90°	0.052°	PRO 3600 Digital Protractor
Crimp Tools ^{FO}	0.61 in to 0.25 in	320 μ in	Mitutoyo PH- 3500 PIN Gauge Set

Electrical

MEASURED INSTRUMENT, QUANTITY OR GAUGE	RANGE OR NOMINAL DEVICE SIZE AS APPROPRIATE	CALIBRATION AND MEASUREMENT CAPABILITY EXPRESSED AS AN UNCERTAINTY (\pm)	CALIBRATION EQUIPMENT AND REFERENCE STANDARDS USED
Temperature Calibration, Indication and Control Equipment used with Thermocouple Type E ^{FO}	-250 °C to - 100 °C	0.67 °C	Fluke 5500A Electrical Simulation of Thermocouple Output
	-100 °C to - 25 °C	0.39 °C	
	-25 °C to 350 °C	0.37 °C	
	350 °C to 650 °C	0.38 °C	
	650 °C to 1 000 °C	0.41 °C	
Temperature Calibration, Indication and Control Equipment used with Thermocouple Type J ^{FO}	-210 °C to -100 °C	0.43 °C	
	-100 °C to -30 °C	0.35 °C	
	-30 °C to 150 °C	0.33 °C	
	150 °C to 760 °C	0.35 °C	
	760 °C to 1 200 °C	0.4 °C	
Temperature Calibration, Indication and Control Equipment used with Thermocouple Type K ^{FO}	-2 200 °C to -100 °C	0.48 °C	
	-100 °C to -25 °C	0.36 °C	
	-25 °C to 120 °C	0.35 °C	
	120 °C to 1 000 °C	0.42 °C	
	1 000 °C to 1 372 °C	0.55 °C	



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Temperature Calibration, Indication and Control Equipment used with Thermocouple Type S ^{FO}	0 °C to 250 °C	0.67 °C	Fluke 5500A Electrical Simulation of Thermocouple Output
	250 °C to 400 °C	0.56 °C	
	400 °C to 1 000 °C	0.57 °C	
	1 000 °C to 1 767 °C	0.66 °C	
Temperature Calibration, Indication and Control Equipment used with Thermocouple Type T ^{FO}	-150 °C to 0 °C	0.44 °C	
	0 °C to 120 °C	0.36 °C	
	120 °C to 400 °C	0.34 °C	
Temperature Calibration, Indication and Control Equipment used with RTD Pt 385, 100 Ω ^{FO}	-200 °C to -80 °C	0.1 °C	Fluke 5500A Electrical Simulation of RTD PT-100 Output
	-80 °C to 0 °C	0.1 °C	
	0 °C to 100 °C	0.1 °C	
	100 °C to 300 °C	0.12 °C	
	300 °C to 400 °C	0.13 °C	
	400 °C to 630 °C	0.15 °C	
	630 °C to 800 °C	0.28 °C	
Temperature Calibration, Indication and Control Equipment used with RTD Pt 3926, 100 Ω ^{FO}	-80 °C to 0 °C	0.1 °C	Fluke 5520A Electrical Simulation of RTD PT-100 Output
	0 °C to 100 °C	0.1 °C	
	100 °C to 300 °C	0.12 °C	
	300 °C to 400 °C	0.13 °C	
	400 °C to 610 °C	0.15 °C	
Temperature Calibration, Indication and Control Equipment used with RTD Pt 3926, 120 Ω ^O	-80 °C to 0 °C	0.1 °C	
	0 °C to 100 °C	0.1 °C	
	100 °C to 260 °C	0.12 °C	
Equipment to Measure AC Voltage (at the listed frequencies) ^{FO}			Fluke 5500 A
10 Hz to 45 Hz	1 mV to 33 mV	2 mV + 1.4 mV/V	
45 Hz to 10 kHz	1 mV to 33 mV	0.2 mV + 1.6 mV/V	
10 kHz to 20 kHz	1 mV to 33 mV	0.2 mV + 2 mV/V	
20 kHz to 50 kHz	1 mV to 33 mV	0.2 mV + 2.2 mV/V	
50 kHz to 100 kHz	1 mV to 33 mV	19 mV + 2.5 mV/V	
100 kHz to 500 kHz	1 mV to 33 mV	4.5 mV + 7.2 mV/V	



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Equipment to Measure AC Voltage (at the listed frequencies) ^{F0}			Fluke 5500 A
10 Hz to 45 Hz	33 mV to 330 mV	0.14 mV + 2.7 mV/V	
45 Hz to 10 kHz	33 mV to 330 mV	0.18 mV + 0.5 mV/V	
10 kHz to 20 kHz	33 mV to 330 mV	0.18 mV + 1 mV/V	
20 kHz to 50 kHz	33 mV to 330 mV	0.3 mV + 3 mV/V	
50 kHz to 100 kHz	33 mV to 330 mV	0.5 mV + 8 mV/V	
Equipment to Measure AC Voltage (at the listed frequencies) ^{F0}			
10 Hz to 45 Hz	3.3 V to 33 V	5 mV + 1 mV/V	
45 Hz to 10 kHz	3.3 V to 33 V	4.5 mV + 0.8 mV/V	
10 kHz to 20 KHz	3.3 V to 33 V	5 mV + 1 mV/V	
20 kHz to 50 kHz	3.3 V to 33 V	10 mV + 2.5 mV/V	
50 kHz to 100 kHz	3.3 V to 33 V	20 mV + 3 mV/V	
Equipment to Measure AC Voltage (at the listed frequencies) ^{F0}			
45 Hz to 1 kHz	33 V to 330 V	22 mV + 1 mV/V	
1 kHz to 10 kHz	33 V to 330 V	5 mV + 0.4 mV/V	
10 kHz to 20 kHz	33 V to 330 V	40 mV + 1 mV/V	
Equipment to Measure AC Voltage (at the listed frequencies) ^{F0}			
45 Hz to 1 kHz	330 V to 1 020 V	0.16 V + 0.5 mV/V	
1 kHz to 5 kHz	330 V to 1 020 V	0.2 V + 2 mV/V	
5 kHz to 10 kHz	330 V to 1 020 V	0.7 V + 2.5 mV/V	
Equipment to Output AC Voltage (at the listed frequencies) ^{F0}			Agilent 34401 A
3 Hz to 5 Hz	1 mV to 100 mV	0.066 1 mV + 3.2 μ V/mV	
5 Hz to 10 Hz	1 mV to 100 mV	0.066 2 mV + 4.6 μ V/mV	
10 Hz to 20 kHz	1 mV to 100 mV	0.022 2 mV + 1.3 μ V/mV	
20 kHz to 50 kHz	1 mV to 100 mV	0.022 8 mV + 3 μ V/mV	
50 kHz to 100 kHz	1 mV to 100 mV	0.037 mV + 7.1 μ V/mV	
100 kHz to 300 kHz	1 mV to 100 mV	0.501 mV + 41 μ V/mV	
Equipment to Output AC Voltage (at the listed frequencies) ^{F0}			
3 Hz to 5 Hz	0.1 V to 1 V	1.02 V + 0.3 mV/ V	
5 Hz to 10 Hz	0.1 V to 1 V	0.37 V + 0.3 mV/ V	
10 Hz to 20 kHz	0.1 V to 1 V	0.08 V + 0.3 mV/ V	
20 kHz to 50 kHz	0.1 V to 1 V	0.14 V + 0.5 mV/ V	
50 kHz to 100 kHz	0.1 V to 1 V	0.62 V + 0.8 mV/ V	
100 kHz to 300 kHz	0.1 V to 1 V	4.02 V + 5 mV/ V	



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Equipment to Output AC Voltage (at the listed frequencies) ^{FO}			Agilent 34401 A
3 Hz to 5 Hz	1 V to 10 V	0.011 V + 9.96 mV/V	
5 Hz to 10 Hz	1 V to 10 V	0.006 6 V + 3.9 mV/V	
10 Hz to 20 kHz	1 V to 10 V	0.005 2 V + 1.3 mV/V	
20 kHz to 50 kHz	1 V to 10 V	0.008 8 V + 2.7 mV/V	
50 kHz to 100 kHz	1 V to 10 V	0.022 V + 3.7 mV/V	
100 kHz to 300 kHz	1 V to 10 V	0.07 V + 41 mV/V	
Equipment to Output AC Voltage (at the listed frequencies) ^{FO}			
3 Hz to 5 Hz	10 V to 100 V	0.099 V + 12 mV/V	
5 Hz to 10 Hz	10 V to 100 V	0.046 V + 4 mV/V	
10 Hz to 20 kHz	10 V to 100 V	0.036 V + 1.3 mV/V	
20 kHz to 50 kHz	10 V to 100 V	0.063 V + 2 mV/V	
50 kHz to 100 kHz	10 V to 100 V	0.103 V + 6.9 mV/V	
100 kHz to 300 kHz	10 V to 100 V	0.61 V + 45 mV/V	
Equipment to Measure DC Voltage ^F	0.07 mV to 330 mV	0.006 % of Reading + 3 µV	Fluke 5500A-SC300
	0.51 mV to 3.3 V	0.005 % of Reading + 5 µV	
	0.65 mV to 33 V	0.005 % of Reading + 50 µV	
	30 V to 330 V	0.005 5 % of Reading + 0.5 mV	
	100 V to 1 000 V	0.005 5 % of Reading + 1.5 mV	
Equipment to Output DC Voltage ^{FO}	100 µV to 100 mV	3.24 µV + 1.25 µV/mV	Agilent 34401A
	100 mV to 1 V	0.3 mV + 0.4 µV/mV	
	1 V to 10 V	0.35 mV + 25 µV/V	
	10 V to 100 V	0.6 mV + 46 µV/V	
	100 V to 1 000 V	0.06 V + 0.4 mV/V	
	1 000 V to 35 kV	19.2 V + 0.74 V/kV	
Capacitance Measure ^F 1 kHz to 50 kHz	0.33 nF to 0.5 nF	0.061 nF + 0.008 nF/nF	Fluke 5500A-SC300
	0.5 nF to 1.1 nF	0.079 nF + 0.008 nF/nF	
	1.1 nF to 3.3 nF	0.084 nF + 0.008 nF/nF	
	3.3 nF to 11 nF	0.101 nF + 0.008 nF/nF	
	11 nF to 33 nF	0.353 nF + 0.007 nF/nF	
	33 nF to 110 nF	0.351 nF + 0.007 nF/nF	
	110 nF to 330 nF	1.005 nF + 0.007 nF/nF	
	0.33 µF to 1.1 µF	0.071 2 µF + 0.02 µF/ µF	
	1.1 µF to 3.3 µF	0.183 6 µF + 0.078 µF/ µF	



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Capacitance Measure ^F 1 kHz to 50 kHz	3.3 μ F to 11 μ F	0.184 9 μ F + 0.01 μ F/ μ F	Fluke 5500A-SC300
	11 μ F to 33 μ F	0.185 6 μ F + 0.01 μ F/ μ F	
	33 μ F to 110 μ F	0.271 μ F + 0.011 μ F/ μ F	
	110 μ F to 330 μ F	0.357 μ F + 0.006 μ F/ μ F	
	330 μ F to 1.1 nF	0.185 2 μ F + 0.02 μ F/ μ F	
Oscilloscope Square wave 50 Ω load ^F	-6.6 V to 6.6 V	0.25 % of Reading + 40 μ V	Fluke 5500A/SC300
Oscilloscope Square wave 1 M Ω load ^F	-130 V to 130 V	0.05 % of Reading + 40 μ V	
Oscilloscope Time Marker, 50 Ω load ^F	50 ms to 5 s	(20 + 1 000t) μ s/s	
	1 ns to 20 ms	2.5 μ s/s	
Oscilloscope Leveled Sine Flatness (Relative to 50 kHz) Edge Rise Time into 50 Ω load ^F	5 mV to 5.5V 50 kHz to 100 MHz 100MHz to 300 MHz	1.5 % of Reading + 100 μ V 3 % of Reading + 100 μ V	
DC Current Measure ^{FO}	11 A to 50 A	0.75 % of Reading	High Current DC Supply with Load Bank in Series with EMPRO Shunt 50A/50mV with Agilent 34401A
	50 A to 100 A	0.8 % of Reading	
	75 A to 150 A	0.8 % of Reading	
	150 A to 300 A	0.8 % of Reading	
Inductance Measure ^F	0.07 H to 10 H	2.3 % of Reading + 0.5 μ H	IETLS-400
	10 mH	10 μ H	General Radio 1482-H

1. The CMC (Calibration and Measurement Capability) stated for calibrations included on this scope of accreditation represents the smallest measurement uncertainty attainable by the laboratory when performing a more or less routine calibration of a nearly ideal device under nearly ideal conditions. It is typically expressed at a confidence level of 95 % using a coverage factor k (usually equal to 2). The actual measurement uncertainty associated with a specific calibration performed by the laboratory will typically be larger than the CMC for the same calibration since capability and performance of the device being calibrated and the conditions related to the calibration may reasonably be expected to deviate from ideal to some degree.
2. The laboratories range of calibration capability for all disciplines for which they are accredited is the interval from the smallest calibrated standard to the largest calibrated standard used in performing the calibration. The low end of this range must be an attainable value for which the laboratory has or has access to the standard referenced. Verification of an indicated value of zero in the absence of a standard is common practice in the procedure for many calibrations but by its definition it does not constitute



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Accreditation is granted to the facility to perform the following calibrations:

calibration of zero capacity.

3. The presence of a superscript F means that the laboratory performs calibration of the indicated parameter at its fixed location. Example: Outside Micrometer^F would mean that the laboratory performs this calibration at its fixed location.
4. The presence of a superscript FO means that the laboratory performs calibration of the indicated parameter both at its fixed location and onsite at customer locations. Example: Outside Micrometer^{FO} would mean that the laboratory performs this calibration at its fixed location and onsite at customer locations.
5. Measurement uncertainties obtained for calibrations performed at customer sites can be expected to be larger than the measurement uncertainties obtained at the laboratories fixed location for similar calibrations. This is due to the effects of transportation of the standards and equipment and upon environmental conditions at the customer site which are typically not controlled as closely as at the laboratories fixed location.
6. The term D represents diameter in inches or millimeters as appropriate to the uncertainty statement.
7. The term L represents length in inches or millimeters as appropriate to the uncertainty statement.
8. The term Wt represents weight in pounds or grams (including SI multiple and submultiple units) appropriate to the uncertainty statement.
9. The term t represents time in seconds as appropriate to the uncertainty statement.