



PERRY JOHNSON LABORATORY ACCREDITATION, INC.

Certificate of Accreditation

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

Precision Measurements

20 Hagerty Road, Suite #1, West Chester, PA 19382

(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 April 2017):

Calibration of Chemical, Dimensional, Electrical, Pressure, Mechanical, Temperature, Thermodynamic Measuring and Test Equipment, Weights and Scales
(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

Initial Accreditation Date:

June 6, 2008

Issue Date:

November 9, 2018

Expiration Date:

November 30, 2020

Accreditation No.:

62582

Certificate No.:

L18-520

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

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

Precision Measurements

20 Hagerty Road, Suite #1, West Chester, PA 19382
 Contact Name: Frank Gellner Phone: 610-436-9703

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

Chemical

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
Conductivity ^{FO}	100 μ S/cm	0.94 μ S/cm	Conductivity Solutions
	1 413 μ S/cm	4 μ S/cm	
	5 000 μ S/cm	21 μ S/cm	
	10 000 μ S/cm	29 μ S/cm	
	100 000 μ S/cm	240 μ S/cm	

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	
Outside Micrometers ^{FO}	0.05 in to 40 in	(60 + 0.052L) μ in	Gage Blocks	
	4 in to 40 in	(730 + 0.018L) μ in		
Height Gages ^{FO}	0.05 in to 4 in	(86 + 0.052L) μ in		
	4 in to 40 in	(360 + 0.18L) μ in		
Depth Gages ^{FO}	0.05 in to 4 in	(180 + 0.052L) μ in		
Calipers ^{FO}	0.05 in to 4 in	(310 + 0.052L) μ in		
	4 in to 40 in	(730 + 0.018L) μ in		
Dial Indicators ^{FO}	0.000 5 in to 4 in	(36 + 0.052L) μ in		
Length – Inside Diameter ^F	0.65 in to 1.2 in	0.007 6 L + 8.2 μ in		Ring Gages P&W Labmaster
Length – Outside Diameter ^F	0.05 in to 4 in	0.000 13 L + 3.7 μ in		Gage Blocks P& Labmaster
	4 in to 8 in	0.000 13 L + 13 μ in		



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Temperature Calibration, Indication, and Control Equipment used with Thermocouple Type E ^{FO}	-250 °C to -100 °C	0.56 °C	Fluke 5520A Electrical Simulation of Thermocouple Output
	-100 °C to -25 °C	0.19 °C	
	-25 °C to 350 °C	0.17 °C	
	350 °C to 650 °C	0.19 °C	
	650 °C to 1 000 °C	0.24 °C	
Temperature Calibration, Indication, and Control Equipment used with Thermocouple Type J ^{FO}	-210 °C to -100 °C	0.31 °C	
	-100 °C to -30 °C	0.19 °C	
	-30 °C to 150 °C	0.17 °C	
	150 °C to 760 °C	0.20 °C	
	760 °C to 1 200 °C	0.26 °C	
Temperature Calibration, Indication, and Control Equipment used with Thermocouple Type K ^{FO}	-200 °C to -100 °C	0.37 °C	
	-100 °C to -25 °C	0.21 °C	
	-25 °C to 120 °C	0.19 °C	
	120 °C to 1 000 °C	0.29 °C	
	1 000 °C to 1 372 °C	0.45 °C	
Temperature Calibration, Indication, and Control Equipment used with Thermocouple Type N ^{FO}	-200 °C to -100 °C	0.45 °C	
	-100 °C to -25 °C	0.25 °C	
	-25 °C to 120 °C	0.22 °C	
	120 °C to 410 °C	0.21 °C	
Temperature Calibration, Indication, and Control Equipment used with Thermocouple Type R ^{FO}	410 °C to 1 300 °C	0.31 °C	
	0 °C to 250 °C	0.63 °C	
	250 °C to 400 °C	0.39 °C	
	400 °C to 1 000 °C	0.37 °C	
Temperature Calibration, Indication, and Control Equipment used with Thermocouple Type S ^{FO}	1 000 °C to 1 767 °C	0.45 °C	
	0 °C to 250 °C	0.52 °C	
	250 °C to 1 000 °C	0.40 °C	
	1 000 °C to 1 400 °C	0.41 °C	
Temperature Calibration, Indication, and Control Equipment used with Thermocouple Type T ^{FO}	1 400 °C to 1 767 °C	0.51 °C	
	-250 °C to -150 °C	0.7 °C	
	-150 °C to 0 °C	0.27 °C	
	0 °C to 120 °C	0.19 °C	
Temperature Calibration, Indication, and Control Equipment used with Thermocouple Type T ^{FO}	120 °C to 400 °C	0.17 °C	



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Temperature Calibration, Indication and Control Equipment used with RTD Pt 385, 100 Ω ^{FO}	-200 °C to -80 °C	0.05 °C	Electrical Simulation of RTD Output Fluke 5520A
	-80 °C to 0 °C	0.05 °C	
	0 °C to 100 °C	0.04 °C	
	100 °C to 300 °C	0.08 °C	
	300 °C to 400 °C	0.09 °C	
	400 °C to 630 °C	0.11 °C	
	630 °C to 800 °C	0.19 °C	
Temperature Calibration, Indication and Control Equipment used with RTD Pt 385, 200 Ω ^{FO}	-200 °C to -80 °C	0.04 °C	
	-80 °C to 0 °C	0.04 °C	
	0 °C to 100 °C	0.04 °C	
	100 °C to 260 °C	0.05 °C	
	260 °C to 300 °C	0.1 °C	
	300 °C to 400 °C	0.1 °C	
	400 °C to 600 °C	0.12 °C	
Temperature Calibration, Indication and Control Equipment used with RTD Pt 385, 500 Ω ^{FO}	-200 °C to -80 °C	0.04 °C	
	-80 °C to 0 °C	0.05 °C	
	0 °C to 100 °C	0.05 °C	
	100 °C to 260 °C	0.06 °C	
	260 °C to 300 °C	0.07 °C	
	300 °C to 400 °C	0.07 °C	
	400 °C to 600 °C	0.08 °C	
Temperature Calibration, Indication and Control Equipment used with RTD Pt 385, 1 k Ω ^{FO}	-200 °C to -80 °C	0.03 °C	
	-80 °C to 0 °C	0.03 °C	
	0 °C to 100 °C	0.04 °C	
	100 °C to 260 °C	0.05 °C	
	260 °C to 300 °C	0.06 °C	
	300 °C to 400 °C	0.06 °C	
	400 °C to 600 °C	0.07 °C	
	600 °C to 630 °C	0.19 °C	



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Temperature Calibration, Indication and Control Equipment used With RTD Pt 3916, 100 Ω ^{FO}	-200 °C to -190 °C	0.2 °C	Electrical Simulation of RTD Output Fluke 5520A
	-190 °C to -80 °C	0.05 °C	
	-80 °C to 0 °C	0.05 °C	
	0 °C to 100 °C	0.07 °C	
	100 °C to 260 °C	0.07 °C	
	260 °C to 300 °C	0.08 °C	
	300 °C to 400 °C	0.09 °C	
	400 °C to 600 °C	0.1 °C	
Temperature Calibration, Indication and Control Equipment used with RTD Pt 3926, 100 Ω ^{FO}	-200 °C to -80 °C	0.06 °C	
	-80 °C to 0 °C	0.06 °C	
	0 °C to 100 °C	0.07 °C	
	100 °C to 300 °C	0.09 °C	
	300 °C to 400 °C	0.09 °C	
Temperature calibration, Indication and Control Equipment used with RTD Ni 385, 120 Ω ^{FO}	-80 °C to 0 °C	0.07 °C	
	0 °C to 100 °C	0.07 °C	
	100 °C to 260 °C	0.12 °C	
Temperature calibration, Indication and Control Equipment used with RTD Cu 427, 10 Ω ^{FO}	-100 °C to 260 °C	0.4 °C	
Equipment to Measure DC Voltage ^{FO}	0 mV to 330 mV	20 μ V/V + 1.8 μ V	Fluke 5520A
	330 mV to 3.3 V	11 μ V/V + 11 μ V	
	3.3 V to 33 V	11 μ V/V + 23 μ V	
	33 V to 330 V	18 μ V/V + 1 100 μ V	
	330 V to 1 000 V	18 μ V/V + 4 000 μ V	
Equipment to Output DC Voltage ^{FO}	0 mV to 200 mV	6.3 μ V/V + 0.5 μ V	Fluke 8508A
	200 mV to 2 V	3.7 μ V/V + 0.3 μ V	
	2 V to 20 V	3.7 μ V/V + 1 μ V	
	20 V to 200 V	5.8 μ V/V + 10 μ V	
	200 V to 1 000 V	5.9 μ V/V + 100 μ V	
	1 000 V to 10 kV	0.04 % of reading + 0.04 V	Vitretek 4700
	10 kV to 40 kV	2.7 % of reading + 0.1 V	Fluke 80K-40 with Fluke 87 V



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Equipment to Measure DC Current ^{FO}	0 μ A to 330 μ A	120 μ A/A + 0.016 μ A	Fluke 5520A
	330 μ A to 3.3 mA	78 μ A/A + 0.06 μ A	
	3.3 mA to 33 mA	78 μ A/A + 0.5 μ A	
	33 mA to 330 mA	78 μ A/A + 10 μ A	
	330 mA to 1.1 A	160 μ A/A + 40 μ A	
	1.1 A to 3 A	300 μ A/A + 230 μ A	
	3 A to 11 A	390 μ A/A + 900 μ A	
	11 A to 20.5 A	780 μ A/A + 2 500 μ A	
Equipment to Output DC Current ^{FO}	0 nA to 100 nA	43 μ A/A + 0.048 nA	HP 3458A
	100 nA to 1 μ A	32 μ A/A + 0.048 nA	
	1 μ A to 10 μ A	30 μ A/A + 0.12 nA	
	10 μ A to 100 μ A	30 μ A/A + 0.96 nA	Fluke 8508A
	100 μ A to 2 mA	14 μ A/A + 4.1 nA	
	2 mA to 20 mA	15 μ A/A + 41 nA	
	20 mA to 200 mA	52 μ A/A + 0.81 μ A	
	200 mA to 2 A	190 μ A/A + 17 μ A	
	2 A to 20 A	410 μ A/A + 400 μ A	
Equipment to Measure Resistance ^{FO}	0 Ω to 11 Ω	32 $\mu\Omega/\Omega$ + 0.000 8 Ω	Fluke 5520A
	11 Ω to 33 Ω	24 $\mu\Omega/\Omega$ + 0.001 3 Ω	
	33 Ω to 110 Ω	22 $\mu\Omega/\Omega$ + 0.001 3 Ω	
	110 Ω to 330 Ω	22 $\mu\Omega/\Omega$ + 0.002 9 Ω	
	330 Ω to 1.1 k Ω	22 $\mu\Omega/\Omega$ + 0.007 Ω	
	1.1 k Ω to 3.3 k Ω	22 $\mu\Omega/\Omega$ + 0.042 Ω	
	3.3 k Ω to 11 k Ω	22 $\mu\Omega/\Omega$ + 0.12 Ω	
	11 k Ω to 33 k Ω	22 $\mu\Omega/\Omega$ + 0.42 Ω	
	33 k Ω to 110 k Ω	22 $\mu\Omega/\Omega$ + 1.2 Ω	
	110 k Ω to 330 k Ω	25 $\mu\Omega/\Omega$ + 3.3 Ω	
	330 k Ω to 1.1 M Ω	25 $\mu\Omega/\Omega$ + 11 Ω	
	1.1 M Ω to 3.3 M Ω	47 $\mu\Omega/\Omega$ + 48 Ω	
	3.3 M Ω to 11 M Ω	110 $\mu\Omega/\Omega$ + 270 Ω	
	11 M Ω to 33 M Ω	200 $\mu\Omega/\Omega$ + 3.2 k Ω	
	33 M Ω to 110 M Ω	390 $\mu\Omega/\Omega$ + 19 k Ω	
110 M Ω to 330 M Ω	2 400 $\mu\Omega/\Omega$ +110 k Ω		
330 M Ω to 1.1 G Ω	12 000 $\mu\Omega/\Omega$ +1 100 k Ω		



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Equipment to Output Resistance ^{FO}	15 $\mu\Omega$ to 2 Ω	20 $\mu\Omega/\Omega$ + 4 $\mu\Omega$	Fluke 8508A
	2 Ω to 20 Ω	11 $\mu\Omega/\Omega$ + 15 $\mu\Omega$	
	20 Ω to 200 Ω	8.5 $\mu\Omega/\Omega$ + 51 $\mu\Omega$	
	200 Ω to 2 k Ω	8.3 $\mu\Omega/\Omega$ + 510 $\mu\Omega$	
	2 k Ω to 20 k Ω	8.2 $\mu\Omega/\Omega$ + 5.1 m Ω	
	20 k Ω to 200 k Ω	8.6 $\mu\Omega/\Omega$ + 51 m Ω	
	200 k Ω to 2 M Ω	11 $\mu\Omega/\Omega$ + 1 Ω	
	2 M Ω to 20 M Ω	20 $\mu\Omega/\Omega$ + 10 Ω	
	20 M Ω to 200 M Ω	66 $\mu\Omega/\Omega$ + 1 k Ω	
	200 M Ω to 2 G Ω	190 $\mu\Omega/\Omega$ + 100 k Ω	
	2 G Ω to 20 G Ω	1 600 $\mu\Omega/\Omega$ + 1 M Ω	
Equipment to Measure Capacitance ^{FO}	0.19 nF to 0.4 nF	0.39 % of reading + 0.0081 nF	Fluke 5520A
	0.4 nF to 1.1 nF	0.39 % of reading + 0.008 2 nF	
	1.1 nF to 3.3 nF	0.39 % of reading + 0.008 7 nF	
	3.3 nF to 11 nF	0.2 % of reading + 0.011 nF	
	11 nF to 33 nF	0.2 % of reading + 0.081 nF	
	33 nF to 110 nF	0.2 % of reading + 0.11 nF	
	110 nF to 330 nF	0.2 % of reading + 0.32 nF	
	330 nF to 1.1 μ F	0.2 % of reading + 1.1 nF	
	1.1 μ F to 3.3 μ F	0.2 % of reading + 3.2 nF	
	3.3 μ F to 11 μ F	0.2 % of reading + 13 nF	
	11 μ F to 33 μ F	0.32 % of reading + 37 nF	
	33 μ F to 110 μ F	0.35 % of reading + 160 nF	
	110 μ F to 330 μ F	0.35 % of reading + 450 nF	
	330 μ F to 1.1 mF	0.35 % of reading + 1.1 μ F	
	1.1 mF to 3.3 mF	0.35 % of reading + 2.6 μ F	
3.3 mF to 11 mF	0.35 % of reading + 8.3 μ F		
11 mF to 33 mF	0.59 % of reading + 25 μ F		
33 mF to 110 mF	0.86 % of reading + 90 μ F		



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Equipment to Output Capacitance ^{FO}	1 pF to 10 pF	0.1 % of reading + 7.8 fF	Fluke PM6304
	10 pF to 100 pF	0.1 % of reading + 95 fF	
	0.1 nF to 1 nF	0.1 % of reading + 0.6 pF	
	1 nF to 10 nF	0.1 % of reading + 7.7 pF	
	10 to 100 nF	0.1 % of reading + 77 pF	
	0.1 μ F to 1 μ F	0.1 % of reading + 1.3 nF	
	1 μ F to 10 μ F	0.1 % of reading + 13 nF	
	10 μ F to 100 μ F	0.1 % of reading + 0.13 μ F	
Equipment to Output Inductance ^{FO}	0.1 mHz to 1 mHz	0.1 % of reading + 1.5 μ F	HP 3458A
	1 mHz to 10 mHz	0.1 % of reading + 15 μ F	
	10 mHz to 100 mHz	0.1 % of reading + 0.15 mH	
	0.1 Hz to 1 Hz	0.1 % of reading + 1.4 mH	
	1 Hz to 10 Hz	0.1 % of reading + 15 mH	
	10 Hz to 100 Hz	0.1 % of reading + 0.17 H	
	0.1 Hz to 1 kHz	0.5 % of reading + 1.9 H	
Equipment to Output AC Voltage (at the listed frequencies) ^{FO}			HP 3458A
1 Hz to 40 Hz	0.1 mV to 10 mV	350 μ V/V + 3.5 μ V	
40 Hz to 1 kHz	0.1 mV to 10 mV	240 μ V/V + 1.3 μ V	
1 kHz to 20 kHz	0.1 mV to 10 mV	350 μ V/V + 1.3 μ V	
20 kHz to 50 kHz	0.1 mV to 10 mV	1 200 μ V/V + 1.3 μ V	
50 kHz to 100 kHz	0.1 mV to 10 mV	5 800 μ V/V + 16 μ V	
100 kHz to 300 kHz	0.1 mV to 10 mV	47 mV/V + 25 μ V	
Equipment to Output AC Voltage (at the listed frequencies) ^{FO}			
1 Hz to 40 Hz	10 mV to 100 mV	81 μ V/V + 4.8 μ V	
40 Hz to 1 kHz	10 mV to 100 mV	81 μ V/V + 2.6 μ V	
1 kHz to 20 kHz	10 mV to 100 mV	170 μ V/V + 2.5 μ V	
20 kHz to 50 kHz	10 mV to 100 mV	350 μ V/V + 2.5 μ V	
50 kHz to 100 kHz	10 mV to 100 mV	930 μ V/V + 2.5 μ V	
100 kHz to 300 kHz	10 mV to 100 mV	3 500 μ V/V + 12 μ V	
300 kHz to 1 MHz	10 mV to 100 mV	12 mV/V + 390 μ V	



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Equipment to Output AC Voltage (at the listed frequencies) ^{FO}			HP 3458A
1 Hz to 40 Hz	100 mV to 1 V	81 μ V/V + 47 μ V	
40 Hz to 1 kHz	100 mV to 1 V	81 μ V/V + 24 μ V	
1 kHz to 20 kHz	100 mV to 1 V	170 μ V/V + 77 μ V	
20 kHz to 50 kHz	100 mV to 1 V	350 μ V/V + 140 μ V	
50 kHz to 100 kHz	100 mV to 1 V	930 μ V/V + 300 μ V	
100 kHz to 300 kHz	100 mV to 1 V	3 500 μ V/V + 540 μ V	
300 kHz to 1 MHz	100 mV to 1 V	12 mV/V + 1 400 μ V	
Equipment to Output AC Voltage (at the listed frequencies) ^{FO}			Fluke 8508A
1 Hz to 10 Hz	200 mV to 2 V	160 μ V/V + 121 μ V	
10 Hz to 40 Hz	200 mV to 2 V	130 μ V/V + 21 μ V	
40 Hz to 100 Hz	200 mV to 2 V	110 μ V/V + 21 μ V	
100 Hz to 2 kHz	200 mV to 2 V	80 μ V/V + 21 μ V	
2 kHz to 10 kHz	200 mV to 2 V	120 μ V/V + 21 μ V	
10 kHz to 30 kHz	200 mV to 2 V	230 μ V/V + 41 μ V	
30 kHz to 100 kHz	200 mV to 2 V	600 μ V/V + 210 μ V	
100 kHz to 300 kHz	200 mV to 2 V	3 100 μ V/V + 2 100 μ V	
300 kHz to 1 MHz	200 mV to 2 V	11 mV/V + 20 mV	
Equipment to Output AC Voltage (at the listed frequencies) ^{FO}			HP 3458A
1 Hz to 40 Hz	0.1 V to 1 V	70 μ V/V + 40 μ V	
40 Hz to 1 kHz	0.1 V to 1 V	70 μ V/V + 20 μ V	
1 kHz to 20 kHz	0.1 V to 1 V	140 μ V/V + 20 μ V	
20 kHz to 50 kHz	0.1 V to 1 V	300 μ V/V + 20 μ V	
50 kHz to 100 kHz	0.1 V to 1 V	800 μ V/V + 20 μ V	
100 kHz to 300 kHz	0.1 V to 1 V	3 mV/V + 0.1 mV	
300 kHz to 1 MHz	0.1 V to 1 V	10 mV/V + 0.1 mV	
1 MHz to 2 MHz	0.1 V to 1 V	15 mV/V + 0.1 mV	



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Equipment to Output AC Voltage (at the listed frequencies) ^{FO}			HP 3458A
1 Hz to 40 Hz	1 V to 10 V	70 μ V/V + 400 μ V	
40 Hz to 40 Hz	1 V to 10 V	70 μ V/V + 200 μ V	
1 kHz to 20 kHz	1 V to 10 V	140 μ V/V + 200 μ V	
20 kHz to 50 kHz	1 V to 10 V	300 μ V/V + 200 μ V	
50 kHz to 100 kHz	1 V to 10 V	800 μ V/V + 200 μ V	
100 kHz to 300 kHz	1 V to 10 V	3 mV/V + 1 mV	
300 kHz to 1 MHz	1 V to 10 V	10 mV/V + 1 mV	
1 MHz to 2 MHz	1 V to 10 V	15 mV/V + 1 mV	
Equipment to Output AC Voltage (at the listed frequencies) ^{FO}			Fluke 8508A
1 Hz to 10 Hz	2 V to 20 V	160 μ V/V + 1 300 μ V	
10 Hz to 40 Hz	2 V to 20 V	130 μ V/V + 210 μ V	
40 Hz to 100 Hz	2 V to 20 V	97 μ V/V + 210 μ V	
100 Hz to 2 kHz	2 V to 20 V	81 μ V/V + 210 μ V	
2 kHz to 10 kHz	2 V to 20 V	120 μ V/V + 210 μ V	
10 kHz to 30 kHz	2 V to 20 V	230 μ V/V + 410 μ V	
30 kHz to 100 kHz	2 V to 20 V	580 μ V/V + 2 100 μ V	
100 kHz to 300 kHz	2 V to 20 V	3 100 μ V/V + 20 mV	
300 kHz to 1 MHz	2 V to 20 V	11 mV/V + 200 mV	
Equipment to Output AC Voltage (at the listed frequencies) ^{FO}			Fluke 8508A
1 Hz to 10 Hz	20 V to 200 V	160 μ V/V + 13 mV	
10 Hz to 40 Hz	20 V to 200 V	130 μ V/V + 2.1 mV	
40 Hz to 100 Hz	20 V to 200 V	97 μ V/V + 2.1 mV	
100 Hz to 2 kHz	20 V to 200 V	79 μ V/V + 2.1 mV	
2 kHz to 10 kHz	20 V to 200 V	120 μ V/V + 2.1 mV	
10 kHz to 30 kHz	20 V to 200 V	230 μ V/V + 4.1 mV	
30 kHz to 100 kHz	20 V to 200 V	580 μ V/V + 21 mV	
100 kHz to 300 kHz	20 V to 200 V	3 100 μ V/V + 200 mV	
300 kHz to 1 MHz	20 V to 200 V	11 mV/V + 2 000 mV	



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

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
Equipment to Output AC Voltage (at the listed frequencies) ^{FO}			HP 3458A
1 Hz to 40 Hz	10 V to 100 V	0.2 mV/V + 4 mV	
40 Hz to 1 kHz	10 V to 100 V	0.2 mV/V + 2 mV	
1 kHz to 20 kHz	10 V to 100 V	0.2 mV/V + 2 mV	
20 kHz to 50 kHz	10 V to 100 V	0.35 mV/V + 2 mV	
50 kHz to 100 kHz	10 V to 100 V	1.2 mV/V + 2 mV	
100 kHz to 300 kHz	10 V to 100 V	4 mV/V + 10 mV	
300 kHz to 1 MHz	10 V to 100 V	15 mV/V + 10 mV	
Equipment to Output AC Voltage (at the listed frequencies) ^{FO}			Fluke 8508A
1 Hz to 40 Hz	100 V to 1 000 V	0.4 mV/V + 40 mV	
40 Hz to 1 kHz	100 V to 1 000 V	0.4 mV/V + 20 mV	
1 kHz to 20 kHz	100 V to 1 000 V	0.6 mV/V + 200 mV	
20 kHz to 50 kHz	100 V to 1 000 V	1.2 mV/V + 20 mV	
50 kHz to 100 kHz	100 V to 1 000 V	3 mV/V + 20 mV	
Equipment to Output AC Voltage (at the listed frequencies) ^{FO}			Vitrek 4700
1 Hz to 10 Hz	200 V to 1 000 V	1 600 μ V/V + 71 mV	
10 Hz to 40 Hz	200 V to 1 000 V	130 μ V/V + 21 mV	
40 Hz to 10 kHz	200 V to 1 000 V	170 μ V/V + 21 mV	
10 kHz to 30 kHz	200 V to 1 000 V	400 μ V/V + 41 mV	
30 kHz to 100 kHz	200 V to 1 000 V	670 μ V/V + 200 mV	
Equipment to Output AC Voltage (at the listed frequencies) ^{FO}			HP 3458A
0.01 Hz to 10 Hz	1 000 V to 10 kV	1.4 mV/V + 0.2 V	
10 Hz to 65 Hz	1 000 V to 10 kV	1.4 mV/V + 0.2 V	
65 Hz to 200 Hz	1 000 V to 10 kV	1.4 mV/V + 0.2 V	
200 Hz to 450 Hz	1 000 V to 10 kV	4.7 mV/V + 0.2 V	
Equipment to Output AC Current (at the listed frequencies) ^{FO}			HP 3458A
10 Hz to 20 Hz	1 μ A to 100 μ A	4 nA/ μ A + 30 nA	
20 Hz to 45 Hz	1 μ A to 100 μ A	1.5 nA/ μ A + 30 nA	
45 Hz to 100 Hz	1 μ A to 100 μ A	0.6 nA/ μ A + 30 nA	
100 Hz to 1 kHz	1 μ A to 100 μ A	0.6 nA/ μ A + 30 nA	



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Equipment to Output AC Current (at the listed frequencies) ^{FO}			Agilent 34401A
3 Hz to 5 kHz	100 μ A to 3A	2 mA/A + 1.2 mA	
5 kHz to 10 kHz	100 μ A to 3A	2 mA/A + 1.2 mA	
Equipment to Output AC Current (at the listed frequencies) ^{FO}			Fluke 8508A
1 Hz to 10 Hz	20 μ A to 200 μ A	510 μ A/A + 0.02 μ A	
10 Hz to 10 kHz	20 μ A to 200 μ A	560 μ A/A + 0.02 μ A	
10 kHz to 30 kHz	20 μ A to 200 μ A	750 μ A/A + 0.02 μ A	
30 kHz to 100 kHz	20 μ A to 200 μ A	4 100 μ A/A + 0.02 μ A	
Equipment to Output AC Current (at the listed frequencies) ^{FO}			
1 Hz to 10 Hz	200 μ A to 2 mA	340 μ A/A + 0.2 μ A	
10 Hz to 10 kHz	200 μ A to 2 mA	320 μ A/A + 0.2 μ A	
10 kHz to 30 kHz	200 μ A to 2 mA	720 μ A/A + 0.2 μ A	
30 kHz to 100 kHz	200 μ A to 2 mA	4 100 μ A/A + 0.2 μ A	
Equipment to Output AC Current (at the listed frequencies) ^{FO}			HP 3458A
10 Hz to 20 Hz	0.1 mA to 1 mA	4 μ A/mA + 200 nA	
20 Hz to 45 Hz	0.1 mA to 1 mA	1.5 μ A/mA + 200 nA	
45 Hz to 100 Hz	0.1 mA to 1 mA	0.6 μ A/mA + 200 nA	
100 Hz to 5 kHz	0.1 mA to 1 mA	0.3 μ A/mA + 200 nA	
5 kHz to 20 kHz	0.1 mA to 1 mA	0.6 μ A/mA + 200 nA	
20 kHz to 50 kHz	0.1 mA to 1 mA	4 μ A/mA + 400 nA	
50 kHz to 100 kHz	0.1 mA to 1 mA	5.5 μ A/mA + 1 500 nA	



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Equipment to Output AC Current (at the listed frequencies) ^{FO}			HP 3458A
10 Hz to 20 Hz	1 mA to 10 mA	4 μ A/mA + 2 μ A	
20 Hz to 45 Hz	1 mA to 10 mA	1.5 μ A/mA + 2 μ A	
45 Hz to 100 Hz	1 mA to 10 mA	0.6 μ A/mA + 2 μ A	
100 Hz to 5 kHz	1 mA to 10 mA	0.3 μ A/mA + 2 μ A	
5 kHz to 20 kHz	1 mA to 10 mA	0.6 μ A/mA + 2 μ A	
20 kHz to 50 kHz	1 mA to 10 mA	4 μ A/mA + 4 μ A	
50 kHz to 100 kHz	1 mA to 10 mA	5.5 μ A/mA + 15 μ A	
Equipment to Output AC Current (at the listed frequencies) ^{FO}			Fluke 8508A
1 Hz to 10 Hz	2 mA to 20 mA	340 μ A/A + 2 μ A	
10 Hz to 10 kHz	2 mA to 20 mA	340 μ A/A + 2 μ A	
10 kHz to 30 kHz	2 mA to 20 mA	730 μ A/A + 2 μ A	
30 kHz to 100 kHz	2 mA to 20 mA	4 100 μ A/A + 2 μ A	
Equipment to Output AC Current (at the listed frequencies) ^{FO}			HP 3458A
10 Hz to 20 Hz	10 mA to 100 mA	4 μ A/mA + 20 μ A	
20 Hz to 45 Hz	10 mA to 100 mA	1.5 μ A/mA + 20 μ A	
45 Hz to 100 Hz	10 mA to 100 mA	0.6 μ A/mA + 20 μ A	
100 Hz to 5 kHz	10 mA to 100 mA	0.3 μ A/mA + 20 μ A	
5 kHz to 20 kHz	10 mA to 100 mA	0.6 μ A/mA + 20 μ A	
20 kHz to 50 kHz	10 mA to 100 mA	4 μ A/mA + 40 μ A	
50 kHz to 100 kHz	10 mA to 100 mA	5.5 μ A/mA + 150 μ A	
Equipment to Output AC Current (at the listed frequencies) ^{FO}			Fluke 8508A
1 Hz to 10 Hz	20 mA to 200 mA	340 μ A/A + 20 μ A	
10 Hz to 10 kHz	20 mA to 200 mA	320 μ A/A + 20 μ A	
10 kHz to 30 kHz	20 mA to 200 mA	640 μ A/A + 20 μ A	
Equipment to Output AC Current (at the listed frequencies) ^{FO}			
10 Hz to 2 k Hz	200 mA to 2 A	630 μ A/A + 200 μ A	
2 kHz to 10 kHz	200 mA to 2 A	940 μ A/A + 200 μ A	
10 kHz to 30 kHz	200 mA to 2 A	31 00 μ A/A + 200 μ A	



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Equipment to Output AC Current (at the listed frequencies) ^{FO}			HP 3458A
10 Hz to 20 Hz	0.1 A to 1 A	4 mA/A + 0.2 mA	
20 Hz to 45 Hz	0.1 A to 1 A	1.6 mA/A + 0.2 mA	
45 Hz to 100 Hz	0.1 A to 1 A	0.8 mA/A + 0.2 mA	
100 Hz to 5 kHz	0.1 A to 1 A	1 mA/A + 0.2 mA	
5 kHz to 20 kHz	0.1 A to 1 A	3 mA/A + 0.2 mA	
20 kHz to 50 kHz	0.1 A to 1 A	10 mA/A + 0.4 mA	
Equipment to Output AC Current (at the listed frequencies) ^{FO}			Fluke 45
20 Hz to 50 Hz	1 A to 10 A	10 mA/A + 10 mA	
50 Hz to 2 kHz	1 A to 10 A	20 mA/A + 10 mA	
Equipment to Output AC Current (at the listed frequencies) ^{FO}			Fluke 8508A
10 Hz to 2 kHz	2 A to 20 A	830 μ A/A + 2 mA	
2 kHz to 10 kHz	2 A to 20 A	2 700 μ A/A + 2 mA	
Equipment to Measure AC Current (at the listed frequencies) ^{FO}			Fluke 5520A
10 Hz to 20 Hz	29 μ A to 330 μ A	0.16 % of reading + 0.09 μ A	
20 Hz to 45 Hz	29 μ A to 330 μ A	0.12 % of reading + 0.09 μ A	
45 Hz to 1 kHz	29 μ A to 330 μ A	0.098 % of reading + 0.09 μ A	
1 kHz to 5 kHz	29 μ A to 330 μ A	0.24 % of reading + 0.14 μ A	
5 kHz to 10 kHz	29 μ A to 330 μ A	0.63 % of reading + 0.18 μ A	
10 kHz to 30 kHz	29 μ A to 330 μ A	1.3 % of reading + 0.37 μ A	
Equipment to Measure AC Current (at the listed frequencies) ^{FO}			Fluke 5520A
10 Hz to 20 Hz	330 μ A to 3.3 mA	0.16 % of reading + 0.4 μ A	
20 Hz to 45 Hz	330 μ A to 3.3 mA	0.098 % of reading + 0.4 μ A	
45 Hz to 1 kHz	330 μ A to 3.3 mA	0.078 % of reading + 0.3 μ A	
1 kHz to 5 kHz	330 μ A to 3.3 mA	0.16 % of reading + 0.4 μ A	
5 kHz to 10 kHz	330 μ A to 3.3 mA	0.39 % of reading + 0.5 μ A	
10 kHz to 30 kHz	330 μ A to 3.3 mA	0.78 % of reading + 0.8 μ A	



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Equipment to Measure AC Current (at the listed frequencies) ^{FO}			Fluke 5520A
10 Hz to 20 Hz	3.3 mA to 33 mA	0.14 % of reading + 6 μ A	
20 Hz to 45 Hz	3.3 mA to 33 mA	0.07 % of reading + 6 μ A	
45 Hz to 1 kHz	3.3 mA to 33 mA	0.032 % of reading + 4 μ A	
1 kHz to 5 kHz	3.3 mA to 33 mA	0.063 % of reading + 4 μ A	
5 kHz to 10 kHz	3.3 mA to 33 mA	0.16 % of reading + 5 μ A	
10 kHz to 30 kHz	3.3 mA to 33 mA	0.32 % of reading + 7 μ A	
Equipment to Measure AC Current (at the listed frequencies) ^{FO}			
10 Hz to 20 Hz	33 mA to 330 mA	0.14 % of reading + 50 μ A	
20 Hz to 45 Hz	33 mA to 330 mA	0.07 % of reading + 50 μ A	
45 Hz to 1 kHz	33 mA to 330 mA	0.032 % of reading + 30 μ A	
1 kHz to 5 kHz	33 mA to 330 mA	0.077 % of reading + 50 μ A	
5 kHz to 10 kHz	33 mA to 330 mA	0.16 % of reading + 90 μ A	
10 kHz to 30 kHz	33 mA to 330 mA	0.24 % of reading + 170 μ A	
Equipment to Measure AC Current (at the listed frequencies) ^{FO}			
10 Hz to 45 Hz	330 mA to 1.1 A	0.14 % of reading + 170 μ A	
45 Hz to 1 kHz	330 mA to 1.1 A	0.039 % of reading + 120 μ A	
1 kHz to 5 kHz	330 mA to 1.1 A	0.47 % of reading + 820 μ A	
5 kHz to 10 kHz	330 mA to 1.1 A	2 % of reading + 4 000 μ A	
Equipment to Measure AC Current (at the listed frequencies) ^{FO}			
10 Hz to 45 Hz	1.1 A to 3 A	0.14 % of reading + 450 μ A	
45 Hz to 1 kHz	1.1 A to 3 A	0.047 % of reading + 280 μ A	
1 kHz to 5 kHz	1.1 A to 3 A	0.47 % of reading + 830 μ A	
5 kHz to 10 kHz	1.1 A to 3 A	2 % of reading + 3 900 μ A	
Equipment to Measure AC Current (at the listed frequencies) ^{FO}			
45 Hz to 100 Hz	3 A to 11 A	0.047 % of reading + 2 500 μ A	
100 Hz to 1 kHz	3 A to 11 A	0.078 % of reading + 2 000 μ A	
1 kHz to 5 kHz	3 A to 11 A	2.4 % of reading + 7 300 μ A	



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Equipment to Measure AC Current (at the listed frequencies) ^{FO}			Fluke 5520A
45 Hz to 100 Hz	11 A to 20 A	0.094 % of reading + 5 900 μ A	
100 Hz to 1 kHz	11 A to 20 A	0.12 % of reading + 5 900 μ A	
1 kHz to 5 kHz	11 A to 20 A	2.4 % of reading + 28 mA	
Equipment to Measure RF Power (at the listed frequencies) ^{FO}			HP 3325B opt 001
0.001 Hz to 100 kHz	4 nW to 100 mW	4.8 % of reading	
100 kHz to 10 MHz	4 nW to 100 mW	15 % of reading	
Equipment to Measure RF Power (at the listed frequencies) ^{FO}			Agilent E8257D Opt 1E1, 532, UNT
10 MHz to 2 GHz	1 pW to 10 mW	21 % of reading	
2 GHz to 20 GHz	100 μ W to 100 mW	21 % of reading	
	100 pW to 100 μ W	23.1 % of reading	
	1 pW to 100 pW	26 % of reading	
20 GHz to 31.8 GHz	100 pW to 100 mW	26 % of reading	
	1 pW to 100 pW	59 % of reading	
Equipment to Output RF Power (at the listed frequencies) ^{FO}			Agilent E4416A Agilent N8482A HP N8481A HP 8485A HP 8481D
100 kHz to 26.5 GHz	10 μ W to 1 W	3.5 % of reading	
10 MHz to 18 GHz	100 pW to 10 μ W	4.6 % of reading	
Equipment to Output RF Attenuation - TRFL (at the listed frequencies) ^{FO}			HP 8902A
2.5 MHz to 1.3 GHz (200 Hz BW) ^{FO}	100 μ W to 1 mW	1.2 % of reading	
	10 μ W to 100 μ W	1.7 % of reading	
	1 μ W to 10 μ W	2.1 % of reading	
	100 nW to 1 μ W	2.6 % of reading	
	10 nW to 100 nW	4 % of reading	
	1 nW to 10 nW	4.5 % of reading	
	100 pW to 1 nW	5 % of reading	
	10 pW to 100 pW	5.5 % of reading	
	1 pW to 10 pW	7 % of reading	
	100 fW to 1 pW	7.4 % of reading	



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1.3 GHz to 26.5 GHz (200 Hz BW) ^{FO}	100 μ W to 1 mW	1.2 % of reading	HP 8902A HP 11793A Agilent E8257D	
	10 μ W to 100 μ W	1.7 % of reading		
	1 μ W to 10 μ W	2.1 % of reading		
	100 nW to 1 μ W	2.6 % of reading		
	10 nW to 100 nW	4 % of reading		
	1 nW to 10 nW	4.5 % of reading		
	100 pW to 1 nW	5 % of reading		
	10 pW to 100 pW	5.5 % of reading		
	1 pW to 10 pW	11.5 % of reading		
100 fW to 1 pW	12 % of reading			
Oscilloscopes Leveled Sine Wave Amplitude 5 mVp-p to 5 Vp-p ^{FO}	50 kHz	2 % of output + 300 μ V	Fluke 5520A	
Leveled Sine Wave Flatness (relative to 50 kHz, Reference) 5 mVp-p to 5 Vp-p ^{FO}	50 kHz to 100 MHz	1.5 % of output + 100 μ V		
	100 MHz to 300 MHz	2 % of output + 100 μ V		
	300 MHz to 600 MHz	4 % of output + 100 μ V		
Square, Sine & Triangle Wave Frequency Range 10 Hz to 100 kHz ^{FO}				
Terminated into 1 M Ω	1.8 mV to 5.5 Vp-p	3 % + 100 μ V		
Terminated into 50 Ω	1.8 mV to 2.5 Vp-p	3 % + 100 μ V		
Time Marker Output	2 ns to 20 ms	2.5 μ s/s		
Equipment to Measure AC Voltage At listed frequencies ^{FO}				
10 Hz to 45 Hz	1 mV to 33 mV	630 μ V/V + 10 μ V		
45 Hz to 10 kHz	1 mV to 33 mV	120 μ V/V + 6 μ V		
10 kHz to 20 kHz	1 mV to 33 mV	160 μ V/V + 6 μ V		
20 kHz to 50 kHz	1 mV to 33 mV	780 μ V/V + 8 μ V		
50 kHz to 100 kHz	1 mV to 33 mV	2 800 μ V/V + 14 μ V		
100 kHz to 500 kHz	1 mV to 33 mV	6 300 μ V/V + 48 μ V		



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Equipment to Measure AC Voltage At listed frequencies ^{FO}			Fluke 5520A
10 Hz to 45 Hz	33 mV to 330 mV	240 μ V/V + 59 μ V	
45 Hz to 10kHz	33 mV to 330 mV	120 μ V/V + 13 μ V	
10 kHz to 20 kHz	33 mV to 330 mV	130 μ V/V + 13 μ V	
20 kHz to 50 kHz	33 mV to 330 mV	280 μ V/V + 18 μ V	
50 kHz to 100kHz	33 mV to 330 mV	630 μ V/V + 35 μ V	
100 kHz to 500kHz	33 mV to 330 mV	1 600 μ V/V + 110 μ V	
Equipment to Measure AC Voltage At listed frequencies ^{FO}			
10 Hz to 45 Hz	330 mV to 3.3 V	240 μ V/V + 550 μ V	
45 Hz to 10kHz	330 mV to 3.3 V	120 μ V/V + 90 μ V	
10 kHz to 20 kHz	330 mV to 3.3 V	150 μ V/V + 90 μ V	
20 kHz to 50 kHz	330 mV to 3.3 V	240 μ V/V + 170 μ V	
50 kHz to 100kHz	330 mV to 3.3 V	550 μ V/V + 270 μ V	
100 kHz to 500kHz	330 mV to 3.3 V	1 900 μ V/V + 1 300 μ V	
Equipment to Measure AC Voltage At listed frequencies ^{FO}			
10 Hz to 45 Hz	0.33 V to 3.3 V	190 μ V/V + 50 μ V	
45 Hz to 10 kHz	0.33 V to 3.3 V	150 μ V/V + 60 μ V	
10 kHz to 20 kHz	0.33 V to 3.3 V	190 μ V/V + 60 μ V	
20 kHz to 50 kHz	0.33 V to 3.3 V	300 μ V/V + 80 μ V	
50 kHz to 100 kHz	0.33 V to 3.3 V	0.7 mV/V + 1.25 mV	
100 kHz to 500 kHz	0.33 V to 3.3 V	2.4 mV/V + 0.6 mV	
Equipment to Measure AC Voltage At listed frequencies ^{FO}			
10 Hz to 45 Hz	3.3 V to 33 V	240 μ V/V + 5 500 μ V	
45 Hz to 10 kHz	3.3 V to 33 V	120 μ V/V + 1 000 μ V	
10 kHz to 20 kHz	3.3 V to 33 V	190 μ V/V + 1 000 μ V	
20 kHz to 50 kHz	3.3 V to 33 V	280 μ V/V + 1 700 μ V	
50 kHz to 100 kHz	3.3 V to 33 V	700 μ V/V + 3 000 μ V	



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Equipment to Measure AC Voltage At listed frequencies ^{FO}			Fluke 5520A
45 Hz to 1 kHz	33 V to 330 V	150 μ V/V + 12 mV	
1 kHz to 10 kHz	33 V to 330 V	160 μ V/V + 13 mV	
10 kHz to 20 kHz	33 V to 330 V	200 μ V/V + 13 mV	
20 kHz to 50 kHz	33 V to 330 V	240 μ V/V + 35 mV	
50 kHz to 100 kHz	33 V to 330 V	1 600 μ V/V + 144 mV	
Equipment to Measure AC Voltage At listed frequencies ^{FO}			Fluke 5520A
45 Hz to 1 kHz	330 V to 1 020 V	240 μ V/V + 40 mV	
1 kHz to 5 kHz	330 V to 1 020 V	200 μ V/V + 40 mV	
5 kHz to 10 kHz	330 V to 1 020 V	240 μ V/V + 40 mV	
Amplitude Flatness ^{FO}	50 kHz to 1.1 GHz	7.6 % of reading + 440 μ V	

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
Scales and Balances ^{FO}	1 mg to 500 mg	0.000 58 % of reading + 0.005 9 mg	Class 1 Weights
	1 g to 1 kg	0.000 21 % of reading + 0.064 mg	
	1 kg to 10 kg	0.000 33 % of reading + 23 mg	
		1 lbf to 600 lbf	0.001 2 % of reading + 0.000 4 lbf
Load Cells/Force Gauges ^{FO}	1 lbf to 600 lbf	0.001 3 % of reading + 0.006 6 lbf	Class F Weights
Load Cells ^{FO} (Tension, Compression)	500 N to 5 000 N	0.24 % of reading	Deadweights Class M1
	200 N to 2 N	0.5 % of reading	
	20 N to 1 779 N	0.5 % of reading	
Weights ^F	1 mg to 500 mg	0.003 4 mg	Class 0 weights Sartorius CCE106 CCE1004
	500 mg to 5 g	0.003 4 mg	
	10 g	0.006 8 mg	
	20 g	0.008 7 mg	
	50 g	0.016 mg	
	100 g	0.031 mg	
	200 g	0.15 mg	
	500 g	0.22 mg	
1 000 g	0.33 mg		



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Pressure ^F	-15 psig to 25 psig	0.008 % of reading + 0.001 6 psig	Ruska 7250-xi
	25 psig to 500 psig	0.01 % of reading + 0.000 9 psig	
	0 psia to 40 psia	0.008 % of reading + 0.001 6 psia	
	40 psia to 515 psia	0.01 % of reading + 0.000 9 psia	
	100 psig to 2 000 psig	0.008 % of reading + 0.064 psig	Ruska 7250
Pressure ^{FO}	200 psig to 10 000 psig	0.000 83 % of reading + 0.006 psig	GE 3100 DWT
	-1 inH ₂ O to 1 inH ₂ O	0.001 6 inH ₂ O	Additel ADT761-LLP
	-10 inH ₂ O to 10 inH ₂ O	0.012 inH ₂ O	
Torque Transducers ^{FO}	1 lbf·in to 100 lbf·in	0.011 % of reading + 0.000 58 lbf·in	Class F Weights/Torque Arm
	0.2 lbf·ft to 1 000 lbf·ft	0.011 % of reading + 0.005 8 lbf·ft	
Torque ^{FO}	2 ozf·in to 20 ozf·in	0.63 % of reading + 0.001 ozf·in	Mountz BMX20Z
	1 lbf·in to 10 lbf·in	0.63 % of reading + 0.001 lbf·in	Mountz BMX10i
	25 lbf·in to 250 lbf·in	0.6 % of reading + 0.01 lbf·in	Mountz BMX250i
	10 lbf·ft to 100 lbf·ft	0.63 % of reading + 0.005 8 lbf·ft	Mountz BMX100F
	25 lbf·ft to 250 lbf·ft	0.7 % of reading + 0.01 lbf·ft	Mountz BMX 250F
Torque ^F	10 lbf·in to 100 lbf·in	0.12 % of reading + 0.02 lbf·in	AKO TDS
	100 lbf·ft to 1 000 lbf·ft	0.12 % of reading + 0.2 lbf·ft	
Mass Flow, Liquids ^{FO}	0.3 kg/m to 1 000 kg/m	0.05 % of reading + 0.005 8 kg/min	Rosemount D100 Flow Sensor Endress Hauser 83F
Mass Flow ^F	1 SCCM to 10 SCCM	0.4 % of reading + 0.00058 SCCM	MolBloc System
	10 SCCM to 100 SCCM	0.4 % of reading + 0.0058 SCCM	
	100 SCCM to 1 000 SCCM	0.4 % of reading + 0.058 SCCM	
	1 SLPM to 10 SLPM	0.4 % of reading + 0.58 SCCM	
	2.5 SLPM to 25 SLPM	0.47 % of reading + 5.8 SCCM	
	10 SLPM to 100 SLPM	0.5 % of reading + 5.8 SCCM	
	50 SLPM to 500 SLPM	0.47 % of reading + 15 SCCM	
Gas Flow ^{FO}	5 sccm to 500 sccm	0.22 % of reading + 0.005 8 sccm	Sierra SL-800
	50 sccm to 5 000 sccm	0.31 % of reading + 0.005 8 sccm	



Certificate of Accreditation: Supplement

Precision Measurements

20 Hagerty Road, Suite #1, West Chester, PA 19382
 Contact Name: Frank Gellner Phone: 610-436-9703

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

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
Temperature measurement with RTD ^F	-196 °C	0.04 °C	Liquid Nitrogen Kaye IRTD
	-80 °C	0.04 °C	Dry Ice Kaye IRTD
	-40 °C to 125 °C	0.04 °C	Temperature Bath Kaye IRTD
	125 °C to 300 °C	0.04 °C	Kaye IRTD
Relative Humidity ^{FO}	0 % RH to 25 % RH	1.3 % RH	Edgetech RH-Cal
	25 % RH to 75 % RH	0.77 % RH	
	75 % RH to 95 % RH	1.3 % RH	
Liquid-In-Glass Thermometers ^F	-40 °C to 125 °C	0.07 °C	Temperature Bath Kaye IRTD
	125 °C to 300 °C	0.07 °C	
Infrared Temperature ^{FO}	20°C to 500 °C	0.55 % of reading + 0.074 °C	Fluke 4181

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
Equipment to Measure Frequency ^{FO}	0.01 Hz to 120 Hz	2.5 μ Hz/Hz + 0.01 Hz	Fluke 5520A
	120 Hz to 1 200 Hz	2.5 μ Hz/Hz + 0.1 Hz	
	1.2 kHz to 12 kHz	2.5 μ Hz/Hz + 1 Hz	
	12 kHz to 120 kHz	2.5 μ Hz/Hz + 10 Hz	
	120 kHz to 1 200 kHz	2.5 μ Hz/Hz + 100 Hz	
	1.2 MHz to 2 MHz	2.5 μ Hz/Hz + 1 kHz	
	0.01 Hz to 225 MHz	2.5 μ Hz/Hz + 5 μ Hz	
Equipment to Measure Frequency ^{FO}	1 Hz to 100 Hz	6 x 10 ⁻¹⁰ Hz	Agilent 53132A
	100 Hz to 1 000 Hz	51 x 10 ⁻⁹ Hz	
	1 kHz to 10 kHz	76 x 10 ⁻⁸ Hz	
	10 kHz to 100 kHz	5.01 μ Hz	
	100 kHz to 1 MHz	50.1 μ Hz	
	1 MHz to 10 MHz	510 μ Hz	
	10 MHz to 100 MHz	5.01 mHz	
	100 MHz to 1 GHz	50.1 mHz	
	1 GHz to 3 GHz	101 mHz	
Stopwatches & Timers ^{FO}	33 kHz	0.09 Hz	Agilent 53132A
Stopwatch / period measuring devices ^{FO}	Up to 100 sec/day	0.051 Sec/Day	Timometer



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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
Phase Modulation ^F	150 kHz to 10 MHz	4 % of reading + 0.5 rad	HP 8902A
	10 MHz to 1 300 MHz	3 % of reading + 0.5 rad	
	1.3 GHz to 26.5 GHz	4 % of reading + 0.5 rad	
Amplitude Modulation ^F Depths: 5 % to 99 %	150 kHz to 10 MHz	2.1 % of reading + 0.012 % AM	
Amplitude Modulation ^F Depths: to 99 %	150 kHz to 10 MHz	3.1 % of reading + 0.012 % AM	
Amplitude Modulation ^F Depths: 5 % to 99 %	10 MHz to 1 300 MHz	1.1 % + 0.012 % AM	
Amplitude Modulation ^F Depths: to 99 %	10 MHz to 1 300 MHz	3.1 % + 0.012 % AM	
Amplitude Modulation ^F Depths: 5 % to 99 %	1.3 GHz to 26.5 GHz	2.1 % + 0.012 % AM	
Amplitude Modulation ^F Depths: to 99 %	1.3 GHz to 26.5 GHz	3.1 % + 0.012 % AM	
Frequency Modulation ^F Rate: 20 Hz to 200 kHz	250 kHz to 10 MHz	2 % of reading + 0.12 kHz	
	10 MHz to 1 300 MHz	5.1 % of reading + 0.02 kHz	
Frequency Modulation ^F Rate: 50 Hz to 100 kHz	10 MHz to 1 300 MHz	1.1 % of reading + 0.02 kHz	
Frequency Modulation ^F Rate: 20 Hz to 200 kHz	1.3 GHz to 26.5 GHz	5.1 % of reading + 0.02 kHz	
Frequency Modulation ^F Rate: 50 Hz to 100 kHz	1.3 GHz to 26.5 GHz	1.1 % of reading + 0.02 kHz	
Rotating Motion ^{FO}	9 rpm to 90 000 rpm	0.000 6 % of reading + 0.000 07 rpm	HP 3325B
Time Interval Measure ^{FO}	1 mS	5.1 nS	Fluke 5520
Period Totalization ^{FO}	0 to 3600 sec	0.001 1 % of reading + 8.2 msec	Stop Watch Control Company



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Precision Measurements

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

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 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 L represents length in inches or millimeters as appropriate to the uncertainty statement.