



National Voluntary Laboratory Accreditation Program



CALIBRATION LABORATORIES

NVLAP LAB CODE 200843-0

> 0 to 36 (25 + 6.3L)

ELECTROMAGNETICS - DC/LF

NVLAP Code: 20/E05
DC Current and Resistance

DC Current Source

<i>Range</i>	<i>Best Uncertainty (±)^{note 1} in $\mu A/A + \mu A$</i>	<i>Remarks</i>
220 μA	35 + 0.006	5700A/EP
2.2 mA	30 + 0.007	5700A/EP
22 mA	32 + 0.04	5700A/EP
220 mA	40 + 0.7	5700A/EP
2.2 A	60 + 12	5700A/EP
11 A	340 + 480	5700A/EP w/ 5725A Amp

DC Current Measure

100 μA	12 + 0.0004	Fluke 8508A
1.0 mA	12 + 0.004	Fluke 8508A
10 mA	14 + 0.04	Fluke 8508A
100 mA	48 + 0.8	Fluke 8508A
1.0 A	190 + 16	Fluke 8508A

DC Resistance – Fixed by direct comparison

<i>Range in Ohms</i>	<i>Best Uncertainty (±)^{note 1} in $\mu\Omega/\Omega$</i>	<i>Remarks</i>
0.1 to 0.01	36	MI 6010B System Time of Test
0.1 to 1	5.6	MI 6010B System Time of Test
1 to 1	0.4	MI 6010B System Time of Test
1 to 10	0.52	MI 6010B System Time of Test
10 to 100	0.59	MI 6010B System Time of Test
100 to 1 k	0.64	MI 6010B System Time of Test
1 k to 10 k	0.68	MI 6010B System Time of Test

2009-04-27 through 2010-03-31

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10k to 100 k

0.7

MI 6010B System Time of Test

DC Resistance – Fixed Source

<i>Range in Ohms</i>	<i>Best Uncertainty (\pm)^{note 1} in $\mu\Omega/\Omega$</i>	<i>Remarks</i>
1	80	5700A/EP Console
1.9	81	5700A/EP Console
10	21	5700A/EP Console
19	21	5700A/EP Console
100	10	5700A/EP Console
190	10	5700A/EP Console
1 k	8.5	5700A/EP Console
1.9 k	8.0	5700A/EP Console
10 k	8.0	5700A/EP Console
19 k	9.5	5700A/EP Console
100 k	9.5	5700A/EP Console
190 k	9.5	5700A/EP Console
1 M	15	5700A/EP Console
1.9 M	14	5700A/EP Console
10 M	33	5700A/EP Console
19 M	56	5700A/EP Console
100 M	190	5700A/EP Console

DC Resistance Measure

<i>Range in Ohms</i>	<i>Best Uncertainty (\pm)^{note 1} in $\mu\Omega/\Omega$ + floor value</i>	<i>Remarks</i>
0 to 10	15 + 81 $\mu\Omega$	Agilent 3458A
10 to 100	11 + 810 $\mu\Omega$	Agilent 3458A
100 to 1k	8.7 + 810 $\mu\Omega$	Agilent 3458A
1k to 10k	8.7 + 8.1 m Ω	Agilent 3458A
10k to 100k	8.7 + 70.6 m Ω	Agilent 3458A
100k to 1 M	12 + 2.3 Ω	Agilent 3458A
1 M to 10 M	50 + 104 Ω	Agilent 3458A
10 M to 100 M	500 + 3163 Ω	Agilent 3458A

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100 M to 1 G

5000 + 226 kΩ

Agilent 3458A

NVLAP Code: 20/E06

DC Current Voltage

Fixed – Direct intercomparison, 4 solid state standards, individual temperature control

Range in VDC	Best Uncertainty (\pm) ^{note 1} in $\mu V/V$	Remarks
10.0	0.33	Fluke 732B

DC Voltage – Variable Source

Range in VDC	Best Uncertainty (\pm) ^{note 1} in $\mu V/V + \mu V$	Remarks
220 mV	6.1 + 0.4	5700A/EP Console
2.2 V	3.6 + 0.7	5700A/EP Console
11 V	2.6 + 2.5	5700A/EP Console
22 V	2.7 + 4	5700A/EP Console
220 V	3.6 + 40	5700A/EP Console
1100 V	4.6 + 400	5700A/EP Console

DC Voltage – Variable Measure

100 mV	5.1 + 0.3	3458A (002 Option)
1 V	4.0 + 0.3	3458A (002 Option)
10 V	4.1 + 0.5	3458A (002 Option)
100 V	6.1 + 30	3458A (002 Option)
1000 V	6.1 + 100	3458A (002 Option)

NVLAP Code: 20/E09

LF AC Voltage – Variable Source (Fluke 5700A/EP Calibrator)

Range (VAC)	Best Uncertainty (\pm) ^{note 1} in $\mu V/V + \mu V$ for indicated frequency range							
	10 – 20 Hz	20 – 40 Hz	40 – 20k Hz	20 - 50 kHz	50 - 100 kHz	100 - 300 kHz	300 - 500 kHz	0.5 – 1 MHz
2.2 mV	220 + 4	85 + 4	76 + 4	180 + 4	460 + 5	900 + 10	1200 + 20	2500 + 20
22 mV	220 + 4	85 + 4	75 + 4	180 + 4	460 + 5	900 + 10	1200 + 20	2500 + 20
220 mV	220 + 12	85 + 7	75 + 7	180 + 7	420 + 17	750 + 20	1200 + 25	2500 + 45
2.2 V	220 + 40	80 + 15	40 + 15	70 + 10	105 + 30	340 + 80	900 + 200	1500 + 300

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22 V	220 + 400	80 + 150	40 + 50	70 + 100	95 + 200	260 + 600	900 + 2000	1300 + 3200
<i>Best Uncertainty (\pm)^{note 1} in $\mu V/V + mV$ for indicated frequency range</i>								
Range (VAC)	10 – 20 Hz	20 – 40 Hz	40 – 20k Hz	20 - 50 kHz	50 - 100 kHz	100 - 300 kHz	300 - 500 kHz	0.5 – 1 MHz
220 V	220 + 4	80 + 1.5	47 + 0.6	75 + 1	130 + 2.5	900 + 16	4400 + 40	7800 + 80
1100 V	300 + 16	15 – 50 Hz ^{note 3} 50 Hz – 1 kHz	70 + 3.5					

AC Voltage Variable – (Fluke 5700A/EP Calibrator w/5725A Amplifier)

<i>Best Uncertainty (\pm)^{note 1} in $\mu V/V + mV$ for indicated frequency range</i>					
Range (VAC)	40 Hz – 1 kHz	1 kHz – 20 kHz	20 kHz – 30 kHz	30 kHz – 50 kHz ^{note 4}	50 kHz – 100 kHz ^{note 4}
1100 V	80 + 4	125 + 6	360 + 11	600 + 11	2300 + 45

AC Voltage – Variable Measure (Fluke 5790A)

<i>Best Uncertainty (\pm)^{note 1,5} in $\mu V/V + \mu V$ for indicated frequency range</i>								
Range (VAC)	10 - 20 Hz	20 Hz - 40 Hz	40 Hz - 20kHz	20 - 50 kHz	50 - 100 kHz	100 - 300 kHz	300 kHz - 500 MHz	500 – 1 MHz
2.2 mV	1700 + 1.3	740 + 1.3	420 + 1.3	810 + 2.0	1200 + 2.5	2300 + 4.0	2400 + 8.0	3500 + 8.0
7 mV	850 + 1.3	370 + 1.3	210 + 1.3	400 + 2.0	600 + 2.5	1200 + 4.0	1300 + 8.0	2300 + 8.0
22 mV	290 + 1.3	190 + 1.3	110 + 1.3	210 + 2.0	310 + 2.5	810 + 4.0	890 + 8.0	1700 + 8.0
70 mV	240 + 1.5	120 + 1.5	65 + 1.5	130 + 2.0	260 + 2.5	510 + 4.0	670 + 8.0	1100 + 8.0
220 mV	210 + 1.5	85 + 1.5	38 + 1.5	69 + 2.0	160 + 2.5	250 + 4.0	380 + 8.0	1200 + 8.0
700 mV	210 + 1.5	76 + 1.5	33 + 1.5	51 + 2.0	79 + 2.5	180 + 4.0	300 + 8.0	960 + 8.0
2.2 V	200	66	24	46	71	160	260	900
7 V	200	67	24	48	81	190	400	1200
22 V	200	67	27	48	81	190	400	1200
70 V	200	68	32	57	94	200	410	1200
220 V	200	68	31	69	98	210	500	
700 V	200	99	41	130	500			

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1000 V 200 99 38 130 500

NVLAP Code: 20/E10

LF AC Capacitance – Measure @ 1kHz

<i>Range in pF</i>	<i>Best Uncertainty (\pm)^{note 1} in $\mu F/F$</i>	<i>Remarks</i>
1 to 1000	10	AH2500

TIME & FREQUENCY

NVLAP Code: 20/F01
Frequency Dissemination
Frequency Transfer

<i>Range</i>	<i>Best Uncertainty (\pm)^{note 1}</i>	<i>Remarks</i>
5 MHz	5 parts in 10^{10}	Fluke 910R
10 MHz	5 parts in 10^{10}	Fluke 910R

NVLAP Code: 20/F05
Stopwatches & Timers

<i>Range</i>	<i>Best Uncertainty (\pm)^{note 1}</i>	<i>Remarks</i>
1 s to 24 hrs	0.05 s	

MECHANICAL

NVLAP Code: 20/M08
Mass - Metric

<i>Range</i>	<i>Best Uncertainty (\pm)^{note 1} in mg</i>	<i>Remarks</i>
20 kg	8.0	Echelon I
10 kg	3.0	Echelon I
5 kg	1.0	Echelon I
3 kg	1.0	Echelon I
2 kg	0.4	Echelon I
1 kg	0.15	Echelon I
500 g	0.10	Echelon I
300 g	0.10	Echelon I

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200 g	0.14	Echelon I
100 g	0.04	Echelon I
50 g	0.020	Echelon I
30 g	0.015	Echelon I
20 g	0.008	Echelon I
10 g	0.007	Echelon I
5 g	0.006	Echelon I
3 g	0.004	Echelon I
2 g	0.004	Echelon I
1 g	0.004	Echelon I
500 mg	0.0025	Echelon I
300 mg	0.0025	Echelon I
200 mg	0.0020	Echelon I
100 mg	0.0020	Echelon I
50 mg	0.0020	Echelon I
30 mg	0.0020	Echelon I
20 mg	0.0016	Echelon I
10 mg	0.0016	Echelon I
5 mg	0.0016	Echelon I
3 mg	0.0016	Echelon I
2 mg	0.0016	Echelon I
1 mg	0.0016	Echelon I

Mass – Avoirdupois

Range	Best Uncertainty (\pm) ^{note 1} in mg	Remarks
25 lb	10	Echelon II
20 lb	10	Echelon II
10 lb	4.90	Echelon II
5 lb	4.60	Echelon II
4 lb	0.87	Echelon II
3 lb	0.86	Echelon II
2 lb	0.33	Echelon II
1 lb	0.27	Echelon II
0.5 lb	0.27	Echelon II

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0.2 lb	0.26	Echelon II
0.1 lb	0.085	Echelon II
0.05 lb	0.082	Echelon II
0.02 lb	0.082	Echelon II
0.01 lb	0.016	Echelon II
0.005 lb	0.013	Echelon II
4 oz	0.260	Echelon II
2 oz	0.086	Echelon II
1 oz	0.082	Echelon II
0.5 oz	0.082	Echelon II
0.25 oz	0.023	Echelon II
0.125 oz	0.013	Echelon II
0.0625 oz	0.012	Echelon II
0.0312 oz	0.005	Echelon II

Balances – Range 5 g to 30 kg

Applies to both in house and remote balance calibrations

<i>Readability in mg</i>	<i>Best Uncertainty (\pm)^{note 1} in mg</i>	<i>Remarks</i>
0.0001	0.0040	
0.001	0.0073	
0.01	0.049	
0.1	0.41	
1.0	6.9	

NVLAP Code: 20/M12

Volume – Pipettes (Gravimetric Method)

<i>Test Volume in μl</i>	<i>Best Uncertainty (\pm)^{note 1} in μl</i>	<i>Remarks</i>
50	0.14	
100	0.21	
500	2.1	
1000	4.1	

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THERMODYNAMICS

NVLAP Code: 20/T02

Humidity

<i>Range in % RH</i>	<i>Best Uncertainty (\pm)^{note 1} in % RH</i>	<i>Remarks</i>
10 to 90	1.2	Chilled Mirror Comparison

NVLAP Code: 20/T03

Laboratory Thermometers

<i>Range in °C</i>	<i>Best Uncertainty (\pm)^{note 1} in °C</i>	<i>Remarks</i>
-80 to 20	0.01	RTD/IPRT/PRT
0 to 100	0.01	RTD/IPRT/PRT
100 to 300	0.02	RTD/IPRT/PRT
200 to 550	0.03	RTD/IPRT/PRT
550 to 660	0.06	RTD/IPRT/PRT

NVLAP Code: 20/T05

Pressure

Direct Pressure Comparison - Pneumatic Deadweight Piston Gages (absolute mode)

<i>Range</i>	<i>Best Uncertainty (\pm)^{note 1} in %</i>	<i>Remarks</i>
0.75 psi to 25 psi [\approx 5 kPa to 172 kPa]	0.0038	Nitrogen
5 psi to 100 psi [\approx 34.5 kPa to 690 kPa]	0.0053	Nitrogen
25 psi to 1000 psi [\approx 690 kPa to 6.9 MPa]	0.0057	Nitrogen

Direct Pressure Comparison - Pneumatic Deadweight Piston Gages (gauge mode)

0.75 psi to 25 psi [\approx 5 kPa to 172 kPa]	0.0038	Nitrogen
5 psi to 100 psi [\approx 34.5 kPa to 690 kPa]	0.0053	Nitrogen
25 psi to 1000 psi [\approx 690 kPa to 6.9 MPa]	0.0057	Nitrogen

Direct Pressure Comparison - Pneumatic Deadweight Piston Gages (gauge mode)

<i>Range</i>	<i>Best Uncertainty (\pm)^{note 1} in % + Pa</i>	<i>Remarks</i>
200 psi to 16 kpsi [\approx 1.4 MPa to 110 MPa]	0.004 + 10	Nitrogen

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Hydraulic Deadweight Piston Gauges (gauge mode) - Direct Pressure Comparison

<i>Range</i>	<i>Best Uncertainty (±)^{note 1} in % + Pa</i>	<i>Remarks</i>
290 psi to 29 kpsi [≈ 2 MPa to 200 MPa]	0.0040 + 27	Oil
725 psi to 75 kpsi [≈ 5 MPa to 515 MPa]	0.0070 + 57	Oil

Secondary Pressure - Low Range Absolute

<i>Range</i>	<i>Best Uncertainty (±)^{note 1} in psi</i>	<i>Remarks</i>
0.2 psi [≈ 1.4 kPa]	0.00036	Nitrogen
1.0 psi [≈ 7.0 kPa]	0.00036	Nitrogen
6.0 psi [≈ 41 kPa]	0.00050	Nitrogen
10 psi [≈ 70 kPa]	0.00092	Nitrogen
15 psi [≈ 100 kPa]	0.0012	Nitrogen
20 psi [≈ 139 kPa]	0.0017	Nitrogen
30 psi [≈ 207 kPa]	0.0025	Nitrogen
40 psi [≈ 276 kPa]	0.0033	Nitrogen
50 psi [≈ 345 kPa]	0.0042	Nitrogen

Secondary Pressure - Low Range Gauge

0.2 psi [≈ 1.4 kPa]	0.00002	Nitrogen
1.0 psi [≈ 7.0 kPa]	0.00008	Nitrogen
6.0 psi [≈ 41 kPa]	0.00064	Nitrogen
10 psi [≈ 70 kPa]	0.00097	Nitrogen
15 psi [≈ 100 kPa]	0.0013	Nitrogen
20 psi [≈ 139 kPa]	0.0017	Nitrogen
30 psi [≈ 276 kPa]	0.0026	Nitrogen
35 psi [≈ 345 kPa]	0.0030	Nitrogen

Secondary Pressure - Mid-Range Absolute

100 psi [≈ 690 kPa]	0.0082	Nitrogen
250 psi [≈ 1.7 MPa]	0.020	Nitrogen
500 psi [≈ 3.4 MPa]	0.041	Nitrogen

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750 psi [≈ 5.7 MPa]	0.061	Nitrogen
1.0 kpsi [≈ 7.0 MPa]	0.082	Nitrogen

NVLAP Code: 20/T07
Resistance Thermometry
Standard Platinum Resistance Thermometer Calibrations

<i>Range in °C</i>	<i>Best Uncertainty (±)^{note 1} in m°C</i>	<i>Material/Equilibrium State</i>
-38.8344	2.7	Hg/Triple Point
0.01	0.6	H2O/Triple Point
29.7646	0.7	Ga/Melting Point
156.5985	3.9	In/Freezing Point
231.928	3.3	Sn/Freezing Point
419.527	4.0	Zn/Freezing Point

NVLAP Code: 20/T08
Thermocouples

<i>Range in °C</i>	<i>Best Uncertainty (±)^{note 1} in °C</i>	<i>Remarks</i>
-80 to 200	0.11	SPRT std. w/ Fluke 8508A
200 to 420	0.11	SPRT std. w/ Fluke 8508A
400 to 700	0.42	S Thermocouple std. w/ Fluke 8508A
700 to 1100	0.62	S Thermocouple std. w/ Fluke 8508A

Thermocouple Readout Methods

<i>Type</i>	<i>ITS-90 Temperature in °C</i>	<i>Best Uncertainty (±)^{note 1} in °C without CJC</i>	<i>Remarks</i>
E	- 240 to 1000	0.92	Fluke 5520A
J	- 200 to 1200	0.11	Fluke 5520A
K	- 200 to 1370	0.11	Fluke 5520A
T	- 240 to 400	0.68	Fluke 5520A
R	0 to 1750	0.16	Fluke 5520A
S	0 to 1750	0.16	Fluke 5520A

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Thermocouple Simulator Methods

<i>Type</i>	<i>ITS-90 Temperature in °C</i>	<i>Best Uncertainty (±)^{note 1} in °C without CJC</i>	<i>Remarks</i>
E	- 240 to 1000	0.084	Fluke 8508A
J	- 200 to 1200	0.099	Fluke 8508A
K	- 200 to 1370	0.084	Fluke 8508A
T	- 240 to 400	0.063	Fluke 8508A
R	0 to 1750	0.085	Fluke 8508A
S	0 to 1750	0.100	Fluke 8508A

RTD Readout Methods

<i>Temperature Range in °C</i>	<i>Best Uncertainty (±)^{note 1} in °C</i>	<i>Remarks</i>
-200 to 0	0.059	5520A, Pt385, 100 ohm
0 to 100	0.082	5520A, Pt385, 100 ohm
100 to 300	0.100	5520A, Pt385, 100 ohm
300 to 400	0.120	5520A, Pt385, 100 ohm
400 to 630	0.140	5520A, Pt385, 100 ohm
630 to 800	0.270	5520A, Pt385, 100 ohm

RTD Simulator Methods

<i>Simulator Range in ohms</i>	<i>Best Uncertainty (±)^{note 1} in °C</i>	<i>Remarks</i>
0 to 2000 ohms	0.016	8508A

NVLAP Code: 20/T09

Vacuum & Low Pressure Gages
Comparison to spinning rotor gauge

<i>Range in Torr</i>	<i>Best Uncertainty (±)^{note 1} in %</i>	<i>Remarks</i>
1 X 10 ⁽⁻⁶⁾ to 1 X 10 ⁽⁻²⁾	11	MKS Model SRG-2CE

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NVLAP Code: 20/T10

Vacuum & Low Pressure Transducers

Comparison to Variable Capacitance Diaphragm Sensor

<i>Range in Torr</i>	<i>Best Uncertainty (\pm)^{note 1} in % + μT</i>	<i>Remarks</i>
0.0004 to 0.01	0.76 + 9	MKS Baratron Model 690A
0.01 to 0.0225	0.76 + 13	MKS Baratron Model 690A
0.0225 to 0.1	0.58 + 48	MKS Baratron Model 690A
0.1 to 1	0.58 + 100	MKS Baratron Model 690A
1 to 10	0.58 + 644	MKS Baratron Model 690A
10 to 100	0.58 + 4950	MKS Baratron Model 690A

1. Represents an expanded uncertainty using a coverage factor, $k = 2$, at an approximate level of confidence of 95 %.
2. L is the length in inches.
3. Maximum output voltage in this frequency range is 250 VAC.
4. Maximum output voltage in this frequency range is 750 VAC.
5. For ranges 2.2 VAC and above, no floor value is given. Any measurement utilizing these ranges will not be below the level of the previous range.

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