



**National Voluntary  
Laboratory Accreditation Program**



**SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005**

**Boeing Puget Sound Metrology**

MC 2R – 40, PO Box 3707

Seattle, WA 98124-2207

Mr. Derek Porter

Phone: 206-544-5267 Fax: 206-544-5292

E-mail: derek.j.porter@boeing.com

URL: www.boeing.com/commercial/techsvcs/boeingtech/index.html

**CALIBRATION LABORATORIES**

**NVLAP LAB CODE 200762-0**

Scope Revised: 2009-10-14

**ELECTROMAGNETICS- DC/LOW FREQUENCY**

*NVLAP Code:* 20/E01

AC/DC Difference for Low Frequency Detectors and Shunts

Direct Comparison with standard shunt

<i>Range</i>	<i>Best Uncertainty (±) in <math>\mu A/A</math> for indicated frequency range <sup>note 1</sup></i>		
	$\leq 20$ kHz	$> 20$ kHz to 50 kHz	$> 50$ kHz to 100 kHz
10 mA	78	112	130
20 mA	78	112	163
30 mA	78	112	163
50 mA	78	112	163
100 mA	78	112	163
200 mA	78	112	163
300 mA	78	112	163
500 mA	78	112	163
1 A	78	112	163
2 A	78	112	198
3 A	78	112	198
5 A	78	112	281
10 A	117	117	173
20 A	117	117	173

2009-01-01 through 2009-12-31

*Effective dates*

*For the National Institute of Standards and Technology*



**National Voluntary  
Laboratory Accreditation Program**



**CALIBRATION LABORATORIES**

**NVLAP LAB CODE 200762-0**  
Scope Revised: 2009-10-14

*NVLAP Code:* 20/E05  
Resistance

<i>Range</i>	<i>Best Uncertainty (±) in <math>\mu\Omega/\Omega</math> <sup>note 1</sup></i>
0.000001 to 0.0001	25
0.0001 to 0.001	5
0.001 to 0.01	0.55
0.01 to 0.1	0.49
0.1 to 1	0.41
1	0.40
1 to 10	0.40
10 to 100	0.40
100 to 10 <sup>3</sup>	0.40
10 <sup>3</sup> to 10 <sup>4</sup>	0.40
10 <sup>4</sup> to 10 <sup>5</sup>	1.40
10 <sup>5</sup> to 10 <sup>6</sup>	1.42
10 <sup>6</sup> to 10 <sup>7</sup>	1.70
10 <sup>7</sup> to 10 <sup>8</sup>	2.02
10 <sup>8</sup> to 10 <sup>9</sup>	2.50
10 <sup>9</sup> to 10 <sup>10</sup>	100
10 <sup>10</sup> to 10 <sup>11</sup>	350
10 <sup>11</sup> to 10 <sup>12</sup>	400
10 <sup>12</sup> to 10 <sup>13</sup>	500

*NVLAP Code:* 20/E06  
DC Voltage

<i>Range in volts</i>	<i>Best Uncertainty (±) in <math>\mu V/V</math> for method indicated <sup>note 1</sup></i>	
	<b>Using 3 Zener Intercomparison</b>	<b>Using Josephson Junction</b>
1.0 to 1.018	0.4	0.2
10	0.19	0.02

2009-01-01 through 2009-12-31

*Effective dates*

*Sally S. Bruce*

*For the National Institute of Standards and Technology*



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 200762-0  
Scope Revised: 2009-10-14

High Voltage- Dividers, Electrostatic Voltmeters, etc.

Range	Mode	Best Uncertainty ( $\pm$ ) in $\mu V/V$ <sup>note 1</sup>
0.1 to 100 kV	DC	300

NVLAP Code: 20/E09  
LF AC Voltage

*Best Uncertainty ( $\pm$ ) in  $\mu V/V$  for indicated frequency <sup>note 1</sup>  
Frequency in Hertz*

RANGE	INPUT	10	20	40	100	1 k	10 k	20 k	50 k	100 k	300 k	500 k	800 k	1 M
22mV	2mV	422	422	422	412	412	412	412	446	548	636	750	887	887
22mV	6mV	333	333	298	276	276	276	276	364	426	525	591	730	774
22mV	10mV	96	80	80	80	80	80	80	146	201	256	339	423	467
22mV	20mV	96	80	80	80	80	80	80	146	201	256	339	423	467
220mV	20mV	94	77	77	75	75	75	75	101	172	256	340	424	468
220mV	60mV	56	51	45	41	41	35	35	53	95	174	256	381	381
220mV	100mV	51	45	39	33	21	21	27	27	50	94	135	291	291
220mV	200mV	33	28	17	16	16	16	17	26	44	94	135	274	287
700mV	200mV	34	28	18	16	16	16	17	26	44	94	135	273	286
700mV	600mV	32	24	23	10	9	9	10	10	14	32	38	62	74
2.2 V	600mV	32	26	22	10	8	8	9	11	12	28	32	44	54
2.2 V	1.0 V	32	26	22	10	8	8	8	10	11	27	33	45	54
2.2 V	2.0 V	32	26	22	10	8	8	8	8	10	27	33	45	54
7 V	2.0 V	32	26	22	10	8	8	8	9	10	26	32	38	50
7 V	6.0 V	32	26	22	10	8	8	8	9	10	26	32	38	50
22 V	6.0 V	32	27	23	10	8	8	8	10	10	27	33	50	59
22 V	10 V	32	26	22	10	8	8	8	9	11	26	32	50	59
22 V	20 V	32	26	22	10	9	9	9	10	12	26	32	50	59
70 V	20 V	32	26	22	10	9	9	9	10	14	65	69		
70 V	60 V	33	27	26	10	9	9	9	11	14	32	36		
220 V	60 V	32	26	23	10	9	9	9	17	20	34			
220 V	100 V	32	26	23	10	9	9	10	15	17				
220 V	200 V	45	27	24	12	11	11	11	17	22				

2009-01-01 through 2009-12-31

Effective dates

*Sally S. Bruce*

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 200762-0  
Scope Revised: 2009-10-14

1000V	200 V	50	27	24	15	14	14	14	21	40
1000V	600 V	62	27	27	21	15	15	15	21	44
1000 V	1000 V	62	27	27	24	22	22	23	32	56

**NVLAP Code:** 20/E09  
LF AC Voltage

High Voltage- Dividers, Electrostatic Voltmeters, etc.

<b>Range</b>	<b>Mode</b>	<b>Best Uncertainty (<math>\pm</math>) in <math>\mu V/V</math> <sup>note 1</sup></b>
0.1 to 60 kV	AC (60 Hz)	700

**NVLAP Code:** 20/E10  
LF Capacitance (1 pF to 1  $\mu F$ )

<b>Test Frequency</b>	<b>Best Uncertainty (<math>\pm</math>) <sup>note 1, 2</sup> in <math>\mu F/F + aF</math></b>
50 Hz	20 + 150
100 Hz	15 + 100
1 kHz	6 + 10
10 kHz	12 + 30
20 kHz	25 + 150

**NVLAP Code:** 20/E11  
LF Inductance

<b>Nominal Value</b>	<b>Best Uncertainty (<math>\pm</math>) for the test Frequency Indicated in <math>\mu H/H</math> <sup>note 1</sup></b>		
	<b>100Hz</b>	<b>1khz</b>	<b>10khz</b>
100 $\mu H$	1500	1500	1500
1mH	500	500	800
10mH	500	500	800
100mH	500	500	900
200mH	500	500	
1H	500	800	

2009-01-01 through 2009-12-31

Effective dates

*Sally S. Bruce*

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 200762-0  
Scope Revised: 2009-10-14

2H	500	800
5H	500	1500
10H	500	2700

## TIME & FREQUENCY

**NVLAP Code:** 20/F01  
Frequency Dissemination  
Frequency Stability

<b>Frequency Range</b>	<b>Best Uncertainty (<math>\pm</math>) <sup>note 1</sup></b>	<b>Remarks</b>
10 MHz	1 part in $10^{11}$	Long Term ( per month )
10 MHz	1 part in $10^{11}$	Allan Deviation ( 1 s )
10 MHz	4 parts in $10^{12}$	Allan Deviation ( 10 s )
10 MHz	1 part in $10^{12}$	Allan Deviation ( 100 s )

## MECHANICAL

**NVLAP Code:** 20/M06  
Force

<b>Force Range in lbf</b>	<b>Best Uncertainty (<math>\pm</math>) in % <sup>note 1</sup></b>	<b>Remarks</b>
0.2 to 100	0.008	Deadweight
2 to 1000	0.008	Deadweight
1000 to 50 000	0.005	Deadweight
100 000 to 1 000 000	0.05	Comparison to Load Cell Standard

**NVLAP Code:** 20/M08  
Mass

<b>Nominal Mass</b>	<b>Best Uncertainty (<math>\pm</math>) <sup>note 1</sup> in mg</b>	<b>Remarks</b>
454 kg	710	Echelon III
64 kg	66	Echelon III

2009-01-01 through 2009-12-31

Effective dates

*Sally S. Bruce*

For the National Institute of Standards and Technology



**National Voluntary  
Laboratory Accreditation Program**



**CALIBRATION LABORATORIES**

**NVLAP LAB CODE 200762-0**  
Scope Revised: 2009-10-14

50 kg	66	Echelon III
25 kg	35	Echelon III
20 kg	22	Echelon III
10 kg	1.6	Echelon III
5 kg	0.9	Echelon III
3 kg	0.67	Echelon III
2 kg	0.57	Echelon III
1 kg	0.099	Echelon III
500 g	0.03	Echelon III
300 g	0.024	Echelon III
200 g	0.021	Echelon III
100 g	0.022	Echelon III
50 g	0.018	Echelon III
30 g	0.017	Echelon III
20 g	0.0057	Echelon III
10 g	0.0059	Echelon III
5 g	0.0043	Echelon III
3 g	0.0038	Echelon III
2 g	0.0014	Echelon III
1 g	0.0022	Echelon III
500 mg	0.0010	Echelon III
300 mg	0.00085	Echelon III
200 mg	0.00085	Echelon III
100 mg	0.00085	Echelon III
50 mg	0.00085	Echelon III
30 mg	0.00085	Echelon III
20 mg	0.00085	Echelon III
10 mg	0.00085	Echelon III
5 mg	0.00085	Echelon III
3 mg	0.00085	Echelon III
2 mg	0.00085	Echelon III
1 mg	0.00085	Echelon III

2009-01-01 through 2009-12-31

*Effective dates*

*Sally S. Bruce*

*For the National Institute of Standards and Technology*



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 200762-0  
Scope Revised: 2009-10-14

### RF/ MICROWAVE

**NVLAP Code:** 20/R04  
Electromagnetic Field Strength  
Field Strength Probe Calibrations

<b>Frequency Range</b>	<b>Best Uncertainty (<math>\pm</math>) in %</b> <sup>note 1, 3</sup>
10 kHz to 40 GHz	5.0

**NVLAP Code:** 20/R08  
Antenna Parameters  
Antenna Gain Calibrations (1m, 3m, 10m, far field)  
Linear/ Circular Polarizations Ratios, Axial Ratio, Tilt Angle

Log Spiral Antennas by  
Extrapolation Method

<b>Frequency Range in GHz</b>	<b>Best Uncertainty (<math>\pm</math>) in dB</b> <sup>note 4</sup>	<b>Distance in m</b>
0.2 to 1	1.0	1
1 to 10	1.0	1

Log Periodic Antennas by  
Extrapolation Method

<b>Frequency Range in GHz</b>	<b>Best Uncertainty (<math>\pm</math>) in dB</b> <sup>note 4</sup>	<b>Distance in m</b>
0.02 to 2	1.0	1, 3, 10, FF

Horn Antennas by Gain  
Extrapolation Method

<b>Frequency Range in GHz</b>	<b>Best Uncertainty (<math>\pm</math>) in dB</b> <sup>note 4</sup>	<b>Distance in meters</b>
0.5 to 18	0.5	1
18 to 26.5	0.8	1
26.5 to 40	1.0	1
0.5 to 18	0.5	3
18 to 26.5	0.8	3

2009-01-01 through 2009-12-31

Effective dates

*Sally S. Bruce*

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 200762-0  
Scope Revised: 2009-10-14

26.5 to 40	1.0	3
0.5 to 18	0.5	10
0.5 to 18	0.5	Far Field

**NVLAP Code:** 20/R13  
Attenuators

Reflection  $S_{11}/S_{22}$   
Range 0-1 in Lin Mag, Phase Range  $-180^\circ$  to  $+180^\circ$

<i>Frequency Range</i>	<i>Best Uncertainty (<math>\pm</math>) in Lin Mag<sup>note 1</sup></i>	<i>Best Uncertainty (<math>\pm</math>) in Degrees Phase<sup>note 1</sup></i>	<i>Remarks</i>
300 kHz to 1.3 GHz	0.002	0.6	VNA & 7 mm Cal Kit
1.3 GHz to 3 GHz	0.003	1.478	VNA & 7 mm Cal Kit
3GHz to 6 GHz	0.005	2.387	VNA & 7 mm Cal Kit
0.045 GHz to 2 GHz	0.002	0.4	VNA & 7 mm TRL Cal Kit
2 GHz to 8 GHz	0.0015	1.12	VNA & 7 mm TRL Cal Kit
8 GHz to 18 GHz	0.0015	4.05	VNA & 7 mm TRL Cal Kit
0.045 GHz to 2 GHz	0.004	0.63	VNA & 3.5 mm Cal Kit
2 GHz to 8 GHz	0.005	2.26	VNA & 3.5 mm Cal Kit
8 GHz to 26.5 Hz	0.006	3.02	VNA & 3.5 mm Cal Kit
0.045 GHz to 2 GHz	0.008	0.7	VNA & 2.4 mm Cal Kit
2 GHz to 20 GHz	0.008	4.0	VNA & 2.4 mm Cal Kit
20 GHz to 40 GHz	0.012	5.85	VNA & 2.4 mm Cal Kit
40 GHz to 50 GHz	0.015	11.6	VNA & 2.4 mm Cal Kit

Transmission  $S_{12}/S_{21}$

<i>Range in dB</i>	<i>Best Uncertainty (<math>\pm</math>) in db for Indicated Frequency Range<sup>note 1</sup></i>			<i>Remarks</i>
	<i>0.0003 to 1.3 GHz</i>	<i>1.3 to 3 GHz</i>	<i>3 to 6 GHz</i>	
0 to 20	0.081	0.089	0.120	VNA & 7 mm Cal Kit
20 to 50	0.097	0.097	0.137	VNA & 7 mm Cal Kit
50 to 60	0.134	0.150	0.230	VNA & 7 mm Cal Kit

2009-01-01 through 2009-12-31

Effective dates

*Sally S. Bruce*

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 200762-0

Scope Revised: 2009-10-14

	0.045 to 2 GHz	2 to 8 GHz	8 to 18 GHz	
0 to 20	0.027	0.023	0.023	VNA & 7 mm TRL Cal Kit
20 to 40	0.037	0.040	0.054	VNA & 7 mm TRL Cal Kit
40 to 50	0.075	0.101	0.143	VNA & 7 mm TRL Cal Kit
50 to 60	0.211	0.308	0.447	VNA & 7 mm TRL Cal Kit

	0.045 to 2 GHz	2 to 8 GHz	8 to 20 GHz	20 to 26.5 GHz	
0 to 20	0.044	0.052	0.046	0.054	VNA & 3.5 mm Cal Kit
20 to 40	0.142	0.058	0.057	0.094	VNA & 3.5 mm Cal Kit
40 to 50	0.416	0.079	0.105	0.220	VNA & 3.5 mm Cal Kit
50 to 60	1.35	0.157	0.273	0.651	VNA & 3.5 mm Cal Kit

	0.045 to 2 GHz	2 to 8 GHz	20 to 40 GHz	40 to 50 GHz	
0 to 20	0.038	0.072	0.158	0.241	VNA & 2.4 mm Cal Kit
20 to 40	0.144	0.086	0.317	1.024	VNA & 2.4 mm Cal Kit
40 to 50	0.42	0.142	0.760	3.295	VNA & 2.4 mm Cal Kit
50 to 60	1.362	0.333	2.341		VNA & 2.4 mm Cal Kit

### Attenuators

<i>Frequency Range</i>	<i>Range in dB</i>	<i>Best Uncertainty (+/-) in dB<sup>note 1,5</sup></i>
< 2GHz	0 to 20	M + 0.03
< 2GHz	20 to 40	M + 0.04
< 2GHz	40 to 60	M + 0.06
< 2GHz	60 to 80	M + 0.10
< 2GHz	80 to 100	M + 0.17
< 2GHz	100 to 110	M + 0.19
2 to 26.5 GHz	0 to 10	M + 0.08
2 to 26.5 GHz	10 to 20	M + 0.09
2 to 26.5 GHz	20 to 30	M + 0.10
2 to 26.5 GHz	30 to 40	M + 0.13
2 to 26.5 GHz	40 to 50	M + 0.14
2 to 26.5 GHz	50 to 60	M + 0.16
2 to 26.5 GHz	60 to 70	M + 0.18

2009-01-01 through 2009-12-31

Effective dates

*Sally S. Bruce*

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 200762-0  
Scope Revised: 2009-10-14

2 to 26.5 GHz	70 to 80	M + 0.20
2 to 26.5 GHz	80 to 90	M + 0.31
2 to 26.5 GHz	90 to 100	M + 0.32
2 to 26.5 GHz	100 to 110	M + 0.34

**NVLAP Code:** 20/R17  
RF/ Microwave Power Meters  
Power Sensor Calibration Factor

<b>Power Range</b>	<b>Frequency Range</b>	<b>Best Uncertainty (+/-) in % <sup>note 1,5</sup></b>
10 μW to 100 mW	100 kHz to 1 GHz	M + 1.5
10 μW to 100 mW	1 to 18 GHz	M + 2.0
10 μW to 100 mW	18 to 26.5 GHz	M + 2.5
10 μW to 100 mW	26.5 to 40 GHz	M + 3.5
10 μW to 100 mW	40 to 50 GHz	M + 4.0
100pW to 10 μW	1 to 18 GHz	M + 2.2
100pW to 10 μW	18 to 26.5 GHz	M + 3.7

Tuned RF Power (Relative to 0 dBm)

<b>Frequency Range</b>	<b>Power Range in dB</b>	<b>Best Uncertainty (+/-) in dB</b>
10 MHz to 26.5 GHz	0 to -10	0.020
10 MHz to 26.5 GHz	-10 to -40	0.080
10 MHz to 26.5 GHz	-40 to -50	0.140
10 MHz to 26.5 GHz	-50 to -80	0.200
10 MHz to 26.5 GHz	-80 to -110	0.300
10 MHz to 26.5 GHz	-110 to 120	0.400

2009-01-01 through 2009-12-31

Effective dates

*Sally S. Bruce*

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



CALIBRATION LABORATORIES

NVLAP LAB CODE 200762-0

Scope Revised: 2009-10-14

- 
1. Represents an expanded uncertainty using a coverage factor,  $k = 2$ , at an approximate level of confidence of 95 %.
  2. For frequencies in between stated test frequencies, use the larger value. 1 aF equals  $1 \times 10^{-18}$  F.
  3. The indicated uncertainty is the best for the frequency range and may be up to 40% depending on frequency and measurement data.
  4. The indicated uncertainty is the best for the frequency range. Actual uncertainty may be up to 2 dB depending on frequency, distance, antenna type, polarization, and measurement data.
  5. M indicates mismatch uncertainty that is device under test dependant.

---

2009-01-01 through 2009-12-31

*Effective dates*

A handwritten signature in cursive script that reads 'Sally S. Bruce'.

---

*For the National Institute of Standards and Technology*