



CALIBRATION LABORATORIES

NVLAP LAB CODE 200403-0

Scope Revised: 2013-01-18

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

<p>SWFLANT Metrology Laboratory Operated by Lockheed Martin P.O. Box 47299 Kings Bay, GA 31547 Mr. Fred N. Zuschlag Phone: 912-573-1850 Fax: 912-573-3609 E-mail: fred.n.zuschlag@lmco.com</p>	<p>Parameter(s) of Accreditation Dimensional Electromagnetics – DC/Low Frequency Time and Frequency Mechanical Thermodynamic</p> <p>This laboratory is compliant to ANSI/NCSL Z540-1-1994; Part 1. (NVLAP Code: 20/A01)</p>
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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) ^{Notes 1,2}

Measured Parameter or Device Calibrated	Range	Uncertainty ($k=2$) ^{Note 3}	Remarks
DIMENSIONAL			
<p>NVLAP Code: 20/D03 GAGE BLOCKS Gage Blocks – Steel and Chrome Carbide Chrome Carbide gage blocks to and including 4 inch. (0.01 in to 4.0 in).</p>	<p>0.01 in to < 2.0 in</p> <p>2.0 in to < 3.0 in</p> <p>3.0 in to < 4.0 in</p> <p>4.0 in to < 5.0 in</p> <p>5.0 in to < 12.0 in</p> <p>12.0 in to < 20.0 in</p> <p>20 in</p>	<p>3.7 μin</p> <p>4.9 μin</p> <p>7.1 μin</p> <p>8.3 μin</p> <p>8.7 μin</p> <p>16 μin</p> <p>18 μin</p>	<p>Mechanical Comparison</p>
<p>NVLAP Code: 20/D07 MEASURING WIRES Measuring Wires</p>	<p>0.007227 (80 TPI) to 0.14434 (4 TPI)</p>	<p>12 μin</p>	<p>Universal Measuring Machine with Master Set Calibration</p>
<p>NVLAP Code: 20/D11 SPHERICAL DIAMETER; PLUG/RING GAGES Ring Gages</p>	<p>0.25 in to 6.0 in</p> <p>> 6.0 in to 12.0</p>	<p>25 μin</p> <p>25 μin + 2.0L</p>	<p>Comparison to Gage Blocks</p>

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



CALIBRATION LABORATORIES

NVLAP LAB CODE 200403-0

Scope Revised: 2013-01-18

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) ^{Notes 1,2}

Measured Parameter or Device Calibrated	Range	Uncertainty ($k=2$) ^{Note 3}	Remarks
Plug Gages	0.125 in to 6.0 in > 6.0 in to 10.75 in	25 μ in 25 μ in + 3.0L	Comparison to Gage Blocks
NVLAP Code: 20/D14 THREADED PLUG and RING GAGES Threaded Plug and Ring Gages, 60° Unified			
Pitch Diameter	4 TPI to 80 TPI	48 μ in	Universal Measuring Machine Three Wire Method
Major Diameter	0.073 in to 1.0 in	51 μ in	Universal Measuring Machine
Half Angle	60°	5.0 "	Optical Comparator Inspection

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) ^{Notes 1,2}

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ($k=2$) ^{Note 3}	Remarks
ELECTROMAGNETICS – DC/LOW FREQUENCY				
NVLAP Code: 20/E02 AC RESISTORS AND CURRENT AC Current – Generate	220 μ A	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	330 μ A/A 210 μ A/A 160 μ A/A 350 μ A/A 1500 μ A/A	Fluke 5720A
	2.2 mA	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	280 μ A/A 180 μ A/A 140 μ A/A 260 μ A/A 1500 μ A/A	

2012-04-01 through 2013-03-31

Effective dates

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**National Voluntary
Laboratory Accreditation Program**



CALIBRATION LABORATORIES

NVLAP LAB CODE 200403-0

Scope Revised: 2013-01-18

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (k=2) <small>Note 3</small>	Remarks	
AC Current – Measure	22 mA	10 Hz to 20 Hz	280 µA/A		
		20 Hz to 40 Hz	180 µA/A		
		40 Hz to 1 kHz	140 µA/A		
		1 kHz to 5 kHz	230 µA/A		
		5 kHz to 10 kHz	1400 µA/A		
	220 mA	10 Hz to 20 Hz	280 µA/A		
		20 Hz to 40 Hz	180 µA/A		
		40 Hz to 1 kHz	140 µA/A		
		1 kHz to 5 kHz	230 µA/A		
		5 kHz to 10 kHz	1200 µA/A		
	2.2 A	20 Hz to 40 Hz	290 µA/A		
		40 Hz to 1 kHz	290 µA/A		
		1 kHz to 5 kHz	500 µA/A		
		5 kHz to 10 kHz	7300 µA/A		
	11 A	40 Hz to 1 kHz	490 µA/A		Fluke 5720A with 5725A
		1 kHz to 5 kHz	1100 µA/A		
		5 kHz to 10 kHz	3800 µA/A		
	200 µA	1 Hz to 10 Hz	400 µA/A		Fluke 8508A
		10 Hz to 10 kHz	390 µA/A		
		10 kHz to 30 kHz	770 µA/A		
30 kHz to 100 kHz		4200 µA/A			
2 mA	1 Hz to 10 Hz	400 µA/A			
	10 Hz to 10 kHz	390 µA/A			
	10 kHz to 30 kHz	770 µA/A			
	30 kHz to 100 kHz	4200 µA/A			
	5 kHz to 10 kHz				
20 mA	1 Hz to 10 Hz	400 µA/A			
	10 Hz to 10 kHz	390 µA/A			
	10 kHz to 30 kHz	770 µA/A			
	30 kHz to 100 kHz	4200 µA/A			

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



CALIBRATION LABORATORIES

NVLAP LAB CODE 200403-0

Scope Revised: 2013-01-18

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) ^{Notes 1,2}

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (k=2) ^{Note 3}	Remarks
	200 mA	1 Hz to 10 Hz 10 Hz to 10 kHz 10 kHz to 30 kHz	400 μ A/A 360 μ A/A 720 μ A/A	
	2 A	10 Hz to 2 kHz 2 kHz to 10 kHz 10 kHz to 30 kHz	720 μ A/A 820 μ A/A 3200 μ A/A	
	20 A	10 Hz to 2 kHz 2 kHz to 10 kHz	920 μ A/A 2700 μ A/A	

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) ^{Notes 1,2}

Measured Parameter or Device Calibrated	Range	Uncertainty (k=2) ^{Note 3}	Remarks
NVLAP Code: 20/E05 DC RESISTANCE AND CURRENT DC Resistance – Generate	1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 k Ω 1.9 k Ω 10 k Ω 19 k Ω 100 k Ω 190 k Ω 1 M Ω 1.9 M Ω 10 M Ω 19 M Ω 100 M Ω	97 $\mu\Omega/\Omega$ 97 $\mu\Omega/\Omega$ 24 $\mu\Omega/\Omega$ 24 $\mu\Omega/\Omega$ 11 $\mu\Omega/\Omega$ 11 $\mu\Omega/\Omega$ 9 $\mu\Omega/\Omega$ 9 $\mu\Omega/\Omega$ 9 $\mu\Omega/\Omega$ 9 $\mu\Omega/\Omega$ 12 $\mu\Omega/\Omega$ 12 $\mu\Omega/\Omega$ 21 $\mu\Omega/\Omega$ 22 $\mu\Omega/\Omega$ 41 $\mu\Omega/\Omega$ 48 $\mu\Omega/\Omega$ 110 $\mu\Omega/\Omega$	Fluke 5720A

W. R. M. L.

2012-04-01 through 2013-03-31

Effective dates

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CALIBRATION LABORATORIES

NVLAP LAB CODE 200403-0

Scope Revised: 2013-01-18

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) ^{Notes 1,2}

Measured Parameter or Device Calibrated	Range	Uncertainty ($k=2$) ^{Note 3}	Remarks
DC Resistance – Measure	2 Ω	18 μΩ/Ω	Fluke 8508A
	20 Ω	10 μΩ/Ω	
	200 Ω	8 μΩ/Ω	
	2 kΩ	8 μΩ/Ω	
	20 kΩ	8 μΩ/Ω	
	200 kΩ	8 μΩ/Ω	
	2 MΩ	10 μΩ/Ω	
	20 MΩ	21 μΩ/Ω	
DC Current – Generate	220 μA	69 μA/A	Fluke 5720A Fluke 5720A with 5725A
	2.2 mA	39 μA/A	
	22.0 mA	38 μA/A	
	220 mA	60 μA/A	
	2.2 A	140 μA/A	
	11 A	410 μA/A	
DC Current – Measure	200 μA	15 μA/A	Fluke 8508A
	2.0 mA	15 μA/A	
	20 mA	16 μA/A	
	200 mA	41 μA/A	
	2.0 A	190 μA/A	
	20.0 A	410 μA/A	
NVLAP Code: 20/E06 DC VOLTAGE DC Voltage – Generate	220 mV	9.6 μV/V	Fluke 5720A
	2.2 V	5.5 μV/V	
	11 V	3.9 μV/V	
	22 V	3.8 μV/V	
	V	5.4 μV/V	
	V	7.1 μV/V	
	DC Voltage – Measure	200 mV	
2 V		3.3 μV/V	
20 V		3.3 μV/V	
200 V		4.9 μV/V	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



**National Voluntary
Laboratory Accreditation Program**



CALIBRATION LABORATORIES

NVLAP LAB CODE 200403-0

Scope Revised: 2013-01-18

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) ^{Notes 1,2}

Measured Parameter or Device Calibrated	Range	Uncertainty ($k=2$) ^{Note 3}	Remarks
	1000 V	5.2 μ V/V	

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) ^{Notes 1,2}

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ($k=2$) ^{Note 3}	Remarks
NVLAP Code: 20/E09 LF AC VOLTAGE AC Voltage – Generate <small>Note 8</small>	2.2 mV	10 Hz to 20 Hz	2200 μ V/V	Fluke 5720A
		20 Hz to 40 Hz	2000 μ V/V	
		40 Hz to 20 kHz	2000 μ V/V	
		20 kHz to 50 kHz	2100 μ V/V	
		50 kHz to 100 kHz	2900 μ V/V	
		100 kHz to 300 kHz	5800 μ V/V	
		300 kHz to 500 kHz	11000 μ V/V	
	500 kHz to 1 MHz	13000 μ V/V		
	22 mV	10 Hz to 20 Hz	440 μ V/V	
		20 Hz to 40 Hz	280 μ V/V	
		40 Hz to 20 kHz	270 μ V/V	
		20 kHz to 50 kHz	390 μ V/V	
		50 kHz to 100 kHz	740 μ V/V	
		100 kHz to 300 kHz	1600 μ V/V	
		300 kHz to 500 kHz	2400 μ V/V	
	500 kHz to 1 MHz	3700 μ V/V		
220 mV	10 Hz to 20 Hz	310 μ V/V		
	20 Hz to 40 Hz	130 μ V/V		
	40 Hz to 20 kHz	120 μ V/V		
	20 kHz to 50 kHz	240 μ V/V		
	50 kHz to 100 kHz	550 μ V/V		
	100 kHz to 300 kHz	1100 μ V/V		
	300 kHz to 500 kHz	1600 μ V/V		
500 kHz to 1 MHz	3000 μ V/V			
2.2 V	10 Hz to 20 Hz	270 μ V/V		

W. R. M. L.

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



CALIBRATION LABORATORIES

NVLAP LAB CODE 200403-0

Scope Revised: 2013-01-18

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) ^{Notes 1,2}

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (k=2) ^{Note 3}	Remarks	
		20 Hz to 40 Hz	100 µV/V		
		40 Hz to 20 kHz	50 µV/V		
		20 kHz to 50 kHz	82 µV/V		
		50 kHz to 100 kHz	130 µV/V		
		100 kHz to 300 kHz	470 µV/V		
		300 kHz to 500 kHz	1200 µV/V		
		500 kHz to 1 MHz	1900 µV/V		
		22 V	10 Hz to 20 Hz		270 µV/V
		20 Hz to 40 Hz	99 µV/V		
		40 Hz to 20 kHz	49 µV/V		
		20 kHz to 50 kHz	82 µV/V		
		50 kHz to 100 kHz	120 µV/V		
		100 kHz to 300 kHz	310 µV/V		
		300 kHz to 500 kHz	1200 µV/V		
		500 kHz to 1 MHz	1700 µV/V		
		220 V	10 Hz to 20 Hz		270 µV/V
			20 Hz to 40 Hz		99 µV/V
			40 Hz to 20 kHz		56 µV/V
			20 kHz to 50 kHz		87 µV/V
			50 kHz to 100 kHz		170 µV/V
			100 kHz to 300 kHz		1000 µV/V
		300 kHz to 500 kHz	5100 µV/V		
		500 kHz to 1 MHz	11000 µV/V		
	220 V to 250 V	15 Hz to 50 Hz	380 µV/V		
	220 V to 1100 V	50 Hz to 1 kHz	80 µV/V		
	220 V to 1100 V	40 Hz to 1 kHz	96 µV/V	Fluke 5720A/5725A	
		1 kHz to 20 kHz	180 µV/V		
		20 kHz to 30 kHz	630 µV/V		
	220 V to 750 V	30 kHz to 50 kHz	630 µV/V		
		50 kHz to 100 kHz	2500 µV/V		

2012-04-01 through 2013-03-31

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Laboratory Accreditation Program**



CALIBRATION LABORATORIES

NVLAP LAB CODE 200403-0

Scope Revised: 2013-01-18

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) ^{Notes 1,2}

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (k=2) ^{Note 3}	Remarks
AC Voltage – Measure	200 mV	1 Hz to 10 Hz	240 µV/V	Fluke 8508A
		10 Hz to 40 Hz	160 µV/V	
		40 Hz to 100 Hz	140 µV/V	
		100 Hz to 2 kHz	120 µV/V	
		2 kHz to 10 kHz	130 µV/V	
		10 kHz to 30 kHz	360 µV/V	
		30 kHz to 100 kHz	830 µV/V	
	2 V	1 Hz to 10 Hz	210 µV/V	
		10 Hz to 40 Hz	120 µV/V	
		40 Hz to 100 Hz	97 µV/V	
		100 Hz to 2 kHz	77 µV/V	
		2 kHz to 10 kHz	97 µV/V	
		10 kHz to 30 kHz	230 µV/V	
		30 kHz to 100 kHz	620 µV/V	
	20 V	100 kHz to 300 kHz	4100 µV/V	
		300 kHz to 1 MHz	21000 µV/V	
		1 Hz to 10 Hz	210 µV/V	
		10 Hz to 40 Hz	120 µV/V	
		40 Hz to 100 Hz	97 µV/V	
		100 Hz to 2 kHz	77 µV/V	
		2 kHz to 10 kHz	97 µV/V	
	200 V	10 kHz to 30 kHz	230 µV/V	
		30 kHz to 100 kHz	620 µV/V	
		100 kHz to 300 kHz	4100 µV/V	
300 kHz to 1 MHz		21000 µV/V		
1 Hz to 10 Hz		210 µV/V		
10 Hz to 40 Hz		120 µV/V		
40 Hz to 100 Hz		97 µV/V		
100 Hz to 2 kHz	77 µV/V			
	2 kHz to 10 kHz	97 µV/V		
	10 kHz to 30 kHz	230 µV/V		

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



CALIBRATION LABORATORIES

NVLAP LAB CODE 200403-0

Scope Revised: 2013-01-18

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) ^{Notes 1,2}

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (k=2) ^{Note 3}	Remarks
	1000 V	30 kHz to 100 kHz	620 μ V/V	
		100 kHz to 300 kHz	4100 μ V/V	
		1 Hz to 10 Hz	310 μ V/V	
		10 Hz to 40 Hz	170 μ V/V	
		40 Hz to 10 kHz	160 μ V/V	
		10 kHz to 30 kHz	390 μ V/V	
		30 kHz to 100 kHz	1100 μ V/V	

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) ^{Notes 1,2}

Measured Parameter or Device Calibrated	Range	Uncertainty (k=2) ^{Note 3}	Remarks
TIME AND FREQUENCY			
NVLAP Code: 20/F01 FREQUENCY DISSEMINATION Frequency	1 MHz 5 MHz 10 MHz	1.2×10^{-12} Hz 1.2×10^{-12} Hz 1.2×10^{-12} Hz	Symmetricon XLi with GPS
NVLAP Code: 20/F02 TIME DISSEMINATION Time	N/A	1.0 μ s	Symmetricon XLi with GPS
MECHANICAL			
NVLAP Code: 20/M06 FORCE Force	1000 lbf to 10000 lbf	0.15 % of full scale	Load Cell System
NVLAP Code: 20/M08 MASS Metric	20 kg 10 kg 5 kg 2 kg 1 kg 500 g	50 mg 25 mg 13 mg 5 mg 3 mg 3 mg	Echelon III

Walter R. M. L.

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



**National Voluntary
Laboratory Accreditation Program**



CALIBRATION LABORATORIES

NVLAP LAB CODE 200403-0

Scope Revised: 2013-01-18

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) ^{Notes 1,2}

Measured Parameter or Device Calibrated	Range	Uncertainty ($k=2$) ^{Note 3}	Remarks
Avoirdupois	200 g	1 mg	Echelon III
	100 g	0.6 mg	
	50 g	0.4 mg	
	30 g	0.35 mg	
	20 g	0.3 mg	
	10 g	0.2 mg	
	5 g	0.15 mg	
	3 g	0.11 mg	
	2 g	0.10 mg	
	1 g	0.07 mg	
	50 lb	105 mg	
	30 lb	80 mg	
	25 lb	120 mg	
	20 lb	50 mg	
	10 lb	25 mg	
	5 lb	15 mg	
	3 lb	10 mg	
	2 lb	7 mg	
	1 lb	3 mg	
	8 oz	4 mg	
4 oz	1 mg		
2 oz	0.5 mg		
1 oz	0.35 mg		
1/2 oz	0.30 mg		
1/4 oz	0.18 mg		
1/8 oz	0.12 mg		
1/16 oz	0.10 mg		
Weight Hangers	5 lb	200 mg	Double Substitution using ASTM Class 3 weights
	2 lb	40 mg	

2012-04-01 through 2013-03-31

Effective dates

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CALIBRATION LABORATORIES

NVLAP LAB CODE 200403-0

Scope Revised: 2013-01-18

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) ^{Notes 1,2}

Measured Parameter or Device Calibrated	Range	Uncertainty ($k=2$) ^{Note 3}	Remarks
NVLAP Code: 20/M15 TORQUE Strain Gage Torque Standards, increasing torque, non-adjustable, defined scale instruments	100 lbf-ft to 1000 lbf-ft	0.19 % of full scale	Moment arm and dead weights
THERMODYNAMIC			
NVLAP Code: 20/T03 LABORATORY THERMOMETERS, DIGITAL AND ANALOG Bi-metallic Thermometers	32.0 °F to < 150.0 °F	1.0 °F	PRT and Temperature Bath
NVLAP Code: 20/T05 PRESSURE Pressure Gage	10.0 psi to < 80.0 psi 80.0 psi to 200.0 psi 200 psi to < 600 psi 600 psi to 1000 psi 2000 psi to 7250 psi 200 psi to < 2000 psi 2000 psi to < 5000 psi 5000 psi to 10000 psi	0.011 psi 0.013 0.043 psi 0.084 psi 0.41 psi 0.11 psi 0.37 psi 0.68 psi	2465A-754 PG7202 system with PC-7200-100 piston PG7202 system with PC-7200-500 piston PG7202 system with PC-7200-1 piston
Pressure Absolute	0.5 in Hg absolute to < 3.2 in Hg absolute 3.2 in Hg absolute to < 6.4 in Hg absolute 6.4 in Hg absolute to < 9.6 in Hg absolute 9.6 in Hg absolute to < 12.8 in Hg absolute 12.8 in Hg absolute to < 16.0 in Hg absolute	0.0016 in Hg absolute 0.0008 in Hg absolute 0.0009 in Hg absolute 0.0010 in Hg absolute 0.0014 in Hg absolute	2465A-754

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



CALIBRATION LABORATORIES

NVLAP LAB CODE 200403-0

Scope Revised: 2013-01-18

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) ^{Notes 1,2}

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	16.0 in Hg absolute to < 19.2 in Hg absolute	0.0018 in Hg absolute	
	19.2 in Hg absolute to < 22.4 in Hg absolute	0.0014 in Hg absolute	
	22.4 in Hg absolute to < 25.6 in Hg absolute	0.0014 in Hg absolute	
	25.6 in Hg absolute to < 28.8 in Hg absolute	0.0017 in Hg absolute	
	28.8 in Hg absolute to < 32.0 in Hg absolute	0.0013 in Hg absolute	
	32.0 in Hg absolute to 35.0 in Hg absolute	0.0015 in Hg absolute	
NVLAP Code: 20/T07 RESISTANCE THERMOMETRY Temperature – Measuring Equipment	0.0 °C to < 37.0 °C	0.016 °C	PRT and Temperature Baths
	37.0 °C to < 65.0 °C	0.026 °C	
	65.0 °C to < 107.0 °C	0.025 °C	
	107.0 °C to < 148.0 °C	0.025 °C	
	148.0 °C to 150.0 °C	0.032 °C	
END			

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



CALIBRATION LABORATORIES

NVLAP LAB CODE 200403-0

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Notes

Note 1: A Calibration and Measurement Capability (CMC) is a description of the best result of a calibration or measurement (result with the smallest uncertainty of measurement) that is available to the laboratory's customers under normal conditions, when performing more or less routine calibrations of nearly ideal measurement standards or instruments. The CMC is described in the laboratory's scope of accreditation by: the measurement parameter/device being calibrated, the measurement range, the uncertainty associated with that range (see note 3), and remarks on additional parameters, if applicable.

Note 2: Calibration and Measurement Capabilities are traceable to the national measurement standards of the U.S. or to the national measurement standards of other countries and are thus traceable to the internationally accepted representation of the appropriate SI (Système International) unit.

Note 3: The uncertainty associated with a measurement in a CMC is an expanded uncertainty using a coverage factor, $k = 2$, with a level of confidence of approximately 95 %. Units for the measurand and its uncertainty are to match. Exceptions to this occur when marketplace practice employs mixed units, such as when the artifact to be measured is labeled in non-SI units and the uncertainty is given in SI units (Example: 5 lb weight with uncertainty given in mg).

Note 3a: The uncertainty of a specific calibration by the laboratory may be greater than the uncertainty in the CMC due to the condition and behavior of the customer's device and specific circumstances of the calibration. The uncertainties quoted do not include possible effects on the calibrated device of transportation, long term stability, or intended use.

Note 3b: As the CMC represents the best measurement results achievable under normal conditions, the accredited calibration laboratory shall not report smaller uncertainty of measurement than that given in a CMC for calibrations or measurements covered by that CMC.

Note 3c: As described in Note 1, CMCs cover calibrations and measurements that are available to the laboratory's customers under *normal conditions*. However, the laboratory may have the capability to offer special tests, employing special conditions, which yield calibration or measurement results with lower uncertainties. Such special tests are not covered by the CMCs and are outside the laboratory's scope of accreditation. In this case, NVLAP requirements for the labeling, on calibration reports, of results outside the laboratory's scope of accreditation apply. These requirements are set out in Annex A.1.h. of NIST Handbook 150, Procedures and General Requirements.

Note 4: Uncertainties associated with field service calibration may be greater as they incorporate on-site environmental contributions, transportation effects, or other factors that affect the measurements. (This note applies only if marked in the body of the scope.)

Note 5: Values listed with percent (%) are percent of reading or generated value unless otherwise noted.

Note 6: NVLAP accreditation is the formal recognition of specific calibration capabilities. Neither NVLAP nor NIST guarantee the accuracy of individual calibrations made by accredited laboratories.

Note 7: See [NIST Handbook 150](#) for further explanation of these notes.

Note 8: Maximum Volt*Hz capability is 2.2×10^7

2012-04-01 through 2013-03-31

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For the National Institute of Standards and Technology