CALIBRATION LABORATORIES **NVLAP LAB CODE 105013-0**

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

Troemner, LLC **DBA** **Mettler Toledo, LLC** 201 Wolf Drive P.O. Box 87 Thorofare, NJ 08086-0087 Mr. Steve Armstrong Phone: 856-686-4214 Fax: 856-686-1601 E-mail: sarmstrong@troemner.com URL: http://www.troemner.com	**Fields of Calibration** Dimensional Electromagnetics - DC/Low Frequency Time & Frequency Mechanical Thermodynamic This laboratory is compliant to ANSI/NCSL Z540-1-1994; Part 1. (20/A01)

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Expanded Uncertainty Note 3	Remarks
DIMENSIONAL			
LENGTH & DIAMETER; STEP GAGES (20/D05)			
Length Indicators	0.05 in to 1 in > 1 in to 2 in > 2 in to 3 in > 3 in to 4 in > 4 in to 6 in > 6 in to 8 in > 8 in to 10 in > 10 in to 12 in	92 µin 176 µin 191 µin 221 µin 319 µin 326 µin 400 µin 467 µin	Comparison to Gage Blocks

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Expanded Uncertainty Notes 3, 5	Remarks
ELECTROMAGNETICS – DC/LOW FREQUENCY				
AC RESISTORS AND CURRENT (20/E02)				
AC Current – Source and Measure	50 µA to 199.9 µA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz > 10 kHz to 30 kHz	740 µA/A + 35 nA 440 µA/A + 30 nA 200 µA/A + 30 nA 350 µA/A + 75 nA 550 µA/A + 20 nA 1400 µA/A + 0.15 µA	Fluke 8508A, Fluke 5520A

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) [Notes 1,2]

Measured Parameter or Device Calibrated	Range	Frequency Range	Expanded Uncertainty [Notes 3, 5]	Remarks
	200 µA to 1.99 mA	10 Hz to 20 Hz	730 µA/A + 0.3 µA	
		> 20 Hz to 45 Hz	75 µA/A + 0.2 µA	
		> 45 Hz to 1 kHz	77 µA/A + 0.2 µA	
		> 1 kHz to 5 kHz	100 µA/A + 0.2 µA	
		> 5 kHz to 10 kHz	190 µA/A + 0.2 µA	
		> 10 kHz to 30 kHz	1300 µA/A + 0.5 µA	
	2 mA to 19.99 mA	10 Hz to 20 Hz	730 µA/A + 3 µA	
		> 20 Hz to 45 Hz	100 µA/A + 2 µA	
		> 45 Hz to 1 kHz	90 µA/A + 2 µA	
		> 1 kHz to 5 kHz	130 µA/A + 2 µA	
		> 5 kHz to 10 kHz	200 µA/A + 2 µA	
		> 10 kHz to 30 kHz	1300 µA/A + 3 µA	
	20 mA to 199.9 mA	10 Hz to 20 Hz	690 µA/A + 35 µA	
		> 20 Hz to 45 Hz	100 µA/A + 20 µA	
		> 45 Hz to 1 kHz	100 µA/A + 20 µA	
		> 1 kHz to 5 kHz	120 µA/A + 20 µA	
		> 5 kHz to 10 kHz	120 µA/A + 20 µA	
		> 10 kHz to 30 kHz	1200 µA/A + 50 µA	
	200 mA to 1.99 A	10 Hz to 20 Hz	1200 µA/A + 0.4 mA	
		> 20 Hz to 45 Hz	220 µA/A + 0.2 mA	
		> 45 Hz to 1 kHz	220 µA/A + 0.2 mA	
		> 1 kHz to 5 kHz	410 µA/A + 0.7 mA	
		> 5 kHz to 10 kHz	800 µA/A + 2.5 mA	
	2 A to 20 A	20 Hz to 45 Hz	200 µA/A + 0.4 mA	
		> 45 Hz to 1 kHz	500 µA/A + 2 mA	
		> 1 kHz to 5 kHz	1000 µA/A + 17 mA	

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) [Notes 1,2]

Measured Parameter or Device Calibrated	Range	Expanded Uncertainty [Note 3, 5]	Remarks
DC RESISTANCE AND CURRENT (20/E05)			
DC Current – Source and Measure	0 µA to 199.9 µA 200 uA to 1.99 mA 2 mA to 19.99 mA 20 mA to 199.9 mA 200 mA to 1.99 A 2 A to 20 A	40 µA/A + 2 nA 20 µA/A + 4 nA 20 µA/A + 40 nA 26 µA/A +0.8 µA 210 µA/A + 0.12 mA 230 µA/A + 0.12 mA	Fluke 8508A, Fluke 5520A
DC Resistance – Source And Measure	0 Ω to 1.99 Ω 2 Ω to 19.99 Ω 20 Ω to 199.9 Ω 200 Ω to 1.99 kΩ 2 kΩ to 19.99 kΩ 20 kΩ to 199.9 kΩ 200 kΩ to 1.99 MΩ 2 MΩ to 19.99 MΩ 20 MΩ to 199.9 MΩ 200 MΩ to 1 GΩ	125 µΩ/Ω +0.3 mΩ 18 µΩ/Ω + 0.2 mΩ 10 µΩ/Ω + 1 mΩ 10 µΩ/Ω + 3 mΩ 10 µΩ/Ω + 30 mΩ 10 µΩ/Ω + 50 mΩ 10 µΩ/Ω + 7 Ω 38 µΩ/Ω + 0.1 kΩ 240 µΩ/Ω + 1 kΩ 500 µΩ/Ω + 0.4 MΩ	Fluke 8508A, Fluke 5520A
Digital Thermometry Indicators - Resistance Function	10 Ω 25 Ω 100 Ω 300 Ω 10 kΩ 1 Ω to 400 Ω > 400 Ω to 10 kΩ	1 µΩ/Ω 1 µΩ/Ω 1 µΩ/Ω 1 µΩ/Ω 5.0 µΩ/Ω 2.5 µΩ/Ω 5.0 µΩ/Ω	Readout devices that actually measure resistance.
DC VOLTAGE (20/E06)			
DC Voltage – Source and Measure	0 mV to 24.999 mV 25 mV to 199.99 mV 200 mV to 1.99 V 2 V to 19.99 V 20 V to 199.99 V 200 V to 1000 V	74 µV/V + 1.2 µV 13 µV/V + 1.2 µV 5 µV/V + 1.7 µV 5 µV/V + 8 µV 5 µV/V + 400 µV 5 µV/V + 1 mV	Fluke 8508A, Fluke 5520A

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) [Notes 1,2]

Measured Parameter or Device Calibrated	Range	Frequency Range	Expanded Uncertainty [Notes 3, 5]	Remarks
LF AC VOLTAGE (20/E09)				
AC Voltage – Source and Measure	10 mV to 100 mV	75 Hz to 1 kHz	360 µV/V + 3 µV	Fluke 8508A, Fluke 5520A
	100 mV to < 200 mV	10 Hz to 20 Hz	140 µV/V + 14 µV	
		> 20 Hz to 45 Hz	140 µV/V + 5 µV	
		> 45 Hz to 1 kHz	100 µV/V + 5 µV	
		> 1 kHz to 5 kHz	100 µV/V + 5 µV	
		> 5 kHz to 10 kHz	100 µV/V + 5 µV	
		> 10 kHz to 30 kHz	260 µV/V + 5 µV	
		> 30 kHz to 100 kHz	400 µV/V + 50 µV	
	200 mV to < 2 V	10 Hz to 20 Hz	80 µV/V + 150 µV	
		> 20 Hz to 45 Hz	75 µV/V + 50 µV	
		> 45 Hz to 1 kHz	55 µV/V + 50 µV	
		> 1 kHz to 5 kHz	55 µV/V + 50 µV	
		> 5 kHz to 10 kHz	80 µV/V + 50 µV	
		> 10 kHz to 30 kHz	290 µV/V + 50 µV	
		> 30 kHz to 100 kHz	625 µV/V + 50 µV	
	2 V to < 20 V	10 Hz to 20 Hz	150 µV/V + 600 µV	
		> 20 Hz to 45 Hz	150 µV/V + 200 µV	
		> 45 Hz to 1 kHz	150 µV/V + 200 µV	
		> 1 kHz to 5 kHz	150 µV/V + 600 µV	
		> 5 kHz to 10 kHz	150 µV/V + 600 µV	
		> 10 kHz to 30 kHz	150 µV/V + 750 µV	
		> 30 kHz to 100 kHz	250 µV/V + 4 mV	
	20 V to < 200 V	45 Hz to 100 Hz	130 + 2 mV	
		> 100 Hz to 1 kHz	130 + 200 µV	
		> 1 kHz to 5 kHz	130 + 200 µV	
		> 5 kHz to 10 kHz	150 + 200 µV	
		> 10 kHz to 30 kHz	180 + 13 mV	
		> 30 kHz to 100 kHz	700 + 70 mV	

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Expanded Uncertainty Notes 3, 5	Remarks
	200 V to 1000 V	60 Hz to 250 Hz > 250 Hz to 2.5 kHz > 2.5 kHz to 5 kHz > 5 kHz to 10 kHz	75 µV/V + 700 µV 80 µV/V + 30 mV 80 µV/V + 46 mV 220 µV/V + 70 mV	

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Expanded Uncertainty Notes 3, 5	Remarks
TIME AND FREQUENCY			
FREQUENCY DISSEMINATION (20/F01)			
Frequency - Generate	0.11 Hz to 1.99 Hz 2 Hz to 4.99 Hz 5 Hz to 9.99 Hz 10 Hz to 49.99 Hz 50 Hz to 199.9 Hz 200 Hz to 2 MHz	7.5 µHz 10 µHz 18 µHz 3.0 µHz/Hz 2.6 µHz/Hz 2.5 µHz/Hz	Fluke 5520A
STOP WATCHES and TIMERS (20/F05)			
Stop Watches and Timers	Up to 24 hr	0.080 s	Direct comparison to timer/counter
MECHANICAL			
FLOW RATE (20/M05)			
Gas Flow by Comparison to DH Molbloc			Standard conditions 14.7 psia (101 353 Pa) and 70 ºF (21.1 ºC)
N_2	2 sccm to 30 slpm	0.36 %	
Air	2 sccm to 30 slpm	0.48 %	

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) [Notes 1,2]

Measured Parameter or Device Calibrated	Range	Expanded Uncertainty [Notes 3, 5]	Remarks
MASS (20/M08)			
Metric	50 kg	3.1 mg	Echelon I
	30 kg	1.9 mg	
	25 kg	1.5 mg	
	20 kg	1.2 mg	
	10 kg	0.61 mg	
	5 kg	0.29 mg	
	3 kg	0.17 mg	
	2 kg	110 µg	
	1 kg	55 µg	
	500 g	28 µg	
	300 g	18 µg	
	200 g	11 µg	
	100 g	5.7 µg	
	50 g	3.1 µg	
	30 g	2.6 µg	
	20 g	1.4 µg	
	10 g	1.1 µg	
	5 g	0.9 µg	
	3 g	1.1 µg	
	2 g	0.75 µg	
	1 g	0.54 µg	
	500 mg	0.49 µg	
	300 mg	0.49 µg	
	200 mg	0.40 µg	
	100 mg	0.40 µg	
	50 mg	0.23 µg	
	30 mg	0.20 µg	
	20 mg	0.20 µg	
	10 mg	0.20 µg	
	5 mg	0.20 µg	
	3 mg	0.20 µg	
	2 mg	0.20 µg	
	1 mg	0.20 µg	
	0.05 mg to 0.5 mg	0.4 µg	

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) [Notes 1,2]

Measured Parameter or Device Calibrated	Range	Expanded Uncertainty [Notes 3, 5]	Remarks
Metric	500 kg	1.2 g	Echelon II
	250 kg	0.53 g	
	200 kg	0.46 g	
	100 kg	0.44 g	
	50 kg	0.11 g	
	30 kg	45 mg	
	25 kg	28 mg	
	20 kg	24 mg	
	10 kg	12 mg	
	5 kg	10 mg	
	3 kg	10 mg	
	2 kg	6.6 mg	
	1 kg	0.59 mg	
	500 g	0.48 mg	
	300 g	0.40 mg	
	200 g	0.21 mg	
	100 g	0.11 mg	
	50 g	90 µg	
	30 g	69 µg	
	20 g	52 µg	
	10 g	29 µg	
	5 g	14 µg	
	3 g	8.0 µg	
	2 g	8.0 µg	
	1 g	5.0 µg	
	500 mg	5.0 µg	
	300 mg	4.0 µg	
	200 mg	4.0 µg	
	100 mg	4.0 µg	
	50 mg	4.0 µg	
	30 mg	3.7 µg	
	20 mg	3.7 µg	
	10 mg	3.7 µg	
	5 mg	3.7 µg	
	3 mg	3.7 µg	
	2 mg	3.7 µg	
	1 mg	3.7 µg	

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) [Notes 1,2]

Measured Parameter or Device Calibrated	Range	Expanded Uncertainty [Notes 3, 5]	Remarks
Avoirdupois	3000 lb	13 g	Echelon II
	2500 lb	13 g	
	2000 lb	12 g	
	1000 lb	0.90 g	
	500 lb	0.65 g	
	200 lb	0.58 g	
	100 lb	0.16 g	
	50 lb	68 mg	
	25 lb	16 mg	
	20 lb	6.0 mg	
	10 lb	4.0 mg	
	5 lb	2.0 mg	
	3 lb	2.0 mg	
	2 lb	0.47 mg	
	1 lb	0.38 mg	
	0.5 lb	0.28 mg	
	0.3 lb	0.11 mg	
	0.2 lb	57 µg	
	0.1 lb	39 µg	
	0.05 lb	39 µg	
	0.03 lb	24 µg	
	0.02 lb	23 µg	
	0.01 lb	22 µg	
	0.005 lb	14 µg	
	0.003 lb	13 µg	
	0.002 lb	11 µg	
	0.001 lb	11 µg	
Metric	1000 kg	10 g	Echelon III
	500 kg	1.2 g	
	200 kg	0.46 g	
	100 kg	0.44 g	
	50 kg	0.11 g	
	30 kg	65 mg	
	25 kg	38 mg	
	20 kg	33 mg	
	10 kg	37 mg	

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) [Notes 1,2]

Measured Parameter or Device Calibrated	Range	Expanded Uncertainty [Notes 3, 5]	Remarks
	5 kg 3 kg 2 kg 1 kg 500 g 300 g	28 mg 26 mg 23 mg 3.4 mg 2.4 mg 2.3 mg	
VOLUME and DENSITY (20/M12)			
Gravimetric Method	20 ml 10 ml 6 ml 5 ml to 0.1 ml	7.1 µl 6.3 µl 5.8 µl 2.0 µl	Automated Burette
Density in the range of 0.90 g/cm^3 to 8.5 g/cm^3	5 kg 3 kg 2 kg 1 kg 500 g 300 g 200 g 100 g 50 g 30 g 20 g 10 g 5 g 3g 2 g 1 g	1.2 mg/cm^3 1.2 mg/cm^3 1.5 mg/cm^3 1.2 mg/cm^3 1.4 mg/cm^3 3.2 mg/cm^3 5.3 mg/cm^3 2.3 mg/cm^3 3.0 mg/cm^3 6.7 mg/cm^3 2.9 mg/cm^3 3.1 mg/cm^3 17 mg/cm^3 15 mg/cm^3 13 mg/cm^3 16 mg/cm^3	Range value indicates DUT mass value. Density of water determined using silicon sphere. Water density used in determination of solid density
SPEED INDICATORS (20/M14)			
Optical Tachometers	6.6 RPM to 9.9999 RPM 100 RPM to 999.99 RPM 1000 RPM to 9999.9 RPM 10 000 RPM to 24 000 RPM	0.0013 RPM 0.013 RPM 0.13 RPM 1.3 RPM	Fluke 5520A IET/GR 1531-AB

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Expanded Uncertainty Notes 3, 5	Remarks
Rotational Shakers and Stirrers	7 RPM to 3000 RPM	0.6 RPM	Monarch PLT 200
THERMODYNAMIC			
HUMIDITY (20/T02)			
Generate Note 7 Relative Humidity	10 % RH to 95 % RH	0.32 % RH Note 7	Direct Comparison to Thunder Scientific 2500
LABORATORY THERMOMETERS (20/T03)			
Digital Thermometer System	-196 °C -80 °C to -70 °C -70 °C to -40 °C < -40 °C to 0 °C > 0 °C to 100 °C > 100°C to 156 °C > 156 °C to 250 °C > 250 °C to 450 °C > 450 °C to 500 °C 660 °C	0.006 °C 0.010 °C 0.008 °C 0.008 °C 0.007 °C 0.009 °C 0.010 °C 0.014 °C 0.020 °C 0.010 °C	Comparison Method LNBP Comparison Method At fixed point
PRESSURE (20/T05)			
Pneumatic Pressure using Piston Gauge (Absolute Mode) – Direct Pressure Comparison	7 kPa to 350 kPa > 350 kPa to 6895 kPa	0.0016 % + 0.33 Pa 0.0022 % + 1.8 Pa	1.015 psia to 51 psia > 51 psia to 1515 psia
Pneumatic Pressure using Piston Gauge (Gauge Mode) – Direct Pressure Comparison	7 kPa to 350 kPa > 350 kPa to 10 342 kPa	0.0016 % + 0.13 Pa 0.0022 % + 1.6 Pa	1.015 psig to 51 psig > 51 psig to 1515 psig

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) [Notes 1,2]

Measured Parameter or Device Calibrated	Range	Expanded Uncertainty [Notes 3, 5]	Remarks
Pneumatic Effective Area using Piston Gauge- Direct Pressure Comparison	7 kPa to 350 kPa > 350 kPa to 10 342 kPa	0.0015 % + 0.13 Pa 0.0025 % + 1.6 Pa	1.015 psig to 51 psig > 51 psig to 1500 psig
Pneumatic Effective Area using Piston Gauge (Differential Mode)	-94.5 kPa to 260.6 kPa > 260.6 kPa to 6 798 kPa	0.0026 % + 0.33 Pa 0.0031 % + 1.8 Pa	-13.7 psig to 37.8 psig > 37.8 psig to 986 psig
Pressure Drop	20 mmH_2O to 1500 mmH_2O	0.87 % + 0.35 mmH_20	ISO 6565
RESISTANCE THERMOMETRY (20/T07)			
Platinum Resistance Thermometers by Fixed Point			
TPW	0.01 °C	0.27 mK	
Resistance Thermometry	-196 °C -80 °C to -70 °C > -70 °C to -40 °C > -40 °C to 0 °C > 0 °C to 70 °C > 70 °C to 100 °C > 100°C to 156 °C > 156 °C to 250 °C > 250 °C to 450 °C > 450 °C to 500 °C 660 °C	6 mK 10 mK 8 mK 8 mK 7 mK 7 mK 9 mK 10 mK 14 mK 20 mK 10 mK	Comparison Method LNBP Comparison Method
	-40 °C to 0 °C > 0 °C to 70 °C > 70 °C to 100 °C	8 mK 6 mK 6 mK	Thermistors

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Measured Parameter or Device Calibrated	Range	Expanded Uncertainty [Notes 3, 5]	Remarks
THERMOCOUPLES & PYROMETER INDICATORS (20/T08)			
Electrical Simulation of Thermocouples			Fluke 5520A
Type E	-250 °C to -100 °C	0.50 °C	
	> -100 °C to -25 °C	0.16 °C	
	> -25 °C to 350 °C	0.14 °C	
	> 350 °C to 650 °C	0.16 °C	
	> 650 °C to 1000 °C	0.21 °C	
Type J	-210 °C to -100 °C	0.27 °C	
	> -100 °C to -30 °C	0.16 °C	
	> -30 °C to 150 °C	0.14 °C	
	> 150 °C to 760 °C	0.17 °C	
	> 760 °C to 1200 °C	0.23 °C	
Type K	-200 °C to -100 °C	0.33 °C	
	> -100 °C to -25 °C	0.18 °C	
	> -25 °C to 120 °C	0.16 °C	
	> 120 °C to 1000 °C	0.26 °C	
	> 1000 °C to 1372 °C	0.40 °C	
Type T	-250 °C to -150 °C	0.63 °C	
	> -150 °C to 0 °C	0.24 °C	
	> 0 °C to 120 °C	0.16 °C	
	> 120 °C to 400 °C	0.14 °C	
END			

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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 with a level of confidence of approximately 95 %, typically using a coverage factor of $k = 2$. However, laboratories may report a coverage factor different than $k = 2$ to achieve the 95 % level of confidence. 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.5 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: This best-case uncertainty applies when the chamber temperature sensor and device under test sensor are able to be in close proximity.

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