



National Voluntary Laboratory Accreditation Program



CALIBRATION LABORATORIES

NVLAP LAB CODE 200730-0

Scope Revised: 2013/02/05

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

Transcat - Houston 1181 Brittmoore, Suite 600 Houston, TX 77043 Mr. Scott Caine Phone: 713-465-4399 Fax: 713-465-0525 E-mail: scaine@transcat.com URL: www.transcat.com	Parameter(s) of Accreditation Dimensional Electromagnetics – DC/Low Frequency Time and Frequency Mechanical Electromagnetics – RF/Microwave Thermodynamic This laboratory is compliant to ANSI/NCSL Z540-1-1994; Part 1. (20/A01)
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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC)^{Notes 1,2}

Measured Parameter or Device Calibrated	Range	Uncertainty ($k=2$) ^{Note 3,9}	Remarks
DIMENSIONAL			
ANGULAR (20/D01)			
Angles	0° to 90°	8"	CMM
LENGTH & DIAMETER; STEP GAGES (20/D05)			
Micrometers – Outside, Inside, Depth Field calibrations Available ^{Note 4}	0.01 in to 8 in 8 in to 24 in 24 in to 80 in 24 in to 80 in	11 μ in + 14L μ in 46 μ in + 14L μ in 610 μ in 130 μ in	Comparison to Gage Blocks End Standards and CMM; Zero Setting CMM; 0 in to 1 in Micrometer Travel
Anvil Flatness Field calibrations Available ^{Note 4}	0 in to 1 in	6.4 μ in	Optical Flats
Calipers – Outside, Inside, Depth, Step Field calibrations Available ^{Note 4}	0 in to 24 in 24 in to 80 in	46 μ in + 14L μ in 640 μ in	Comparison to Gage Blocks CMM
Dial Indicators	0 in to 4 in	9 μ in + 3.9L μ in	Pratt & Whitney USM
Length Measurement – Single Axis	0 in to 10 in	9 μ in + 3.9L μ in	Pratt & Whitney USM

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Wm R. McQ
 For the National Institute of Standards and Technology



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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ($k=2$) <small>Note 3,9</small>	Remarks
Height Gages	10 in to 40 in	39 μin + 1.4 L μin	Gage Blocks with CMM
	40 in to 80 in	250 μin	CMM
Linear Displacement Field calibrations Available <small>Note 4</small>	0 in to 3 in 3 in to 24 in	37 μin + 0.6 L μin 24 μin + 4.2 L μin	Comparison to Gage Blocks
	0 ft to 12 ft	1.1 μin + 0.6 L μin	Laser Interferometer
SPHERICAL DIAMETER; PLUG/RING GAGES (20/D11)			
Outer Diameters - Plugs	0 in to 10 in	9 μin + 3.9 L μin	Pratt & Whitney USM
SURVEYING RODS and TAPES (20/D13)			
Steel Rules, Tape Measures, and PI Tapes	0 ft to 6 ft	490 μin + 3.5 L μin	CMM with Vision
	6 ft to 100 ft	130 μin + 7.3 L μin	
	6 x 6 in	200 μin	OGP Vision System
THREADED PLUGS & RING GAGES (20/D14)			
Threaded Plugs – Outer Pitch Diameter	0 in to 6 in	83 μin	Comparator with Thread Wires
	0 in to 6 in	9 μin + 3.9 L μin	Comparator
TWO DIMENSIONAL GAGES (20/D15)			
Linear Dimension – Two Axis (X-Y)	20 in x 20 in	130 μin + 7 L μin	Multi-Probing System
COORDINATE MEASURING MACHINES (20/D16)			
Volumetric	0 in ³ to 1 in ³ 1 in ³ to 216 in ³ 0.125 ft ³ to 18 ft ³ 18 ft ³ to 66 ft ³	53 μin 120 μin 310 μin 0.0014 in	CMM

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

Measured Parameter or Device Calibrated	Remarks																			
ELECTROMAGNETICS – DC/LOW FREQUENCY																				
AC RESISTORS (20/E02)																				
AC Current	Fluke A40 Shunts with 792A																			
	Uncertainty (<i>k</i>=2) in $\mu\text{A}/\text{A}$^{Note 3}																			
Range	10 Hz	20 Hz	40 Hz	400 Hz	1 kHz	5 kHz	10 kHz	20 kHz	50 kHz											
100 μA	61	66	56	60	59	72	81	100	120											
200 μA	62	43	38	36	36	63	73	98	120											
1 mA	45	41	31	38	37	37	37	42	46											
2 mA	46	31	31	28	28	28	28	31	39											
10 mA	110	53	33	31	31	31	30	32	55											
20 mA	130	54	33	31	31	31	32	34	63											
100 mA	120	53	33	31	31	31	31	40	73											
200 mA	120	57	33	31	31	31	31	36	73											
1A	110	57	37	35	36	35	38	50	180											
2A	110	60	37	35	36	41	38	52	120											
10A	160	85	64	63	63	63	63	83	150											
20A	220	140	110	110	110	120	140	140	250											

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

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (<i>k</i> =2) ^{Note 3,5}	Remarks
AC Current – Measuring Equipment and Measure Field calibrations Available ^{Note 4}	0 μA to 220 μA 0.22 mA to 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 10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5 kHz	0.03 % + 16 nA 0.02 % + 10 nA 0.015 % + 8 nA 0.03 % + 12 nA 0.11 % + 65 nA 0.03 % + 40 nA 0.018 % + 35 nA 0.014 % + 35 nA 0.02 % + 110 nA	Fluke 5720A

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Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ($k=2$) <small>Note 3,5</small>	Remarks
Clamp-on Ammeter Toroidal Type Field calibrations Available <small>Note 4</small>	2.2 mA to 22 mA	5 kHz to 10 kHz	0.11 % + 650 nA	
		10 Hz to 20 Hz	0.039 % + 400 nA	
		20 Hz to 40 Hz	0.018 % + 350 nA	
		40 Hz to 1 kHz	0.014 % + 350 nA	
		1 kHz to 5 kHz	0.02 % + 550 nA	
	22 mA to 220 mA	5 kHz to 10 kHz	0.11 % + 5 μ A	
		10 Hz to 20 Hz	0.033 % + 4 μ A	
		20 Hz to 40 Hz	0.018 % + 3.5 μ A	
		40 Hz to 1 kHz	0.014 % + 2.5 μ A	
		1 kHz to 5 kHz	0.021 % + 3.5 μ A	
Clamp-on Ammeter Non-Toroidal Type Field calibrations Available <small>Note 4</small>	0.22 A to 2.2 A	5 kHz to 10 kHz	0.11 % + 10 μ A	
		20 Hz to 1 kHz	0.027 % + 35 μ A	
		1 kHz to 5 kHz	0.046 % + 80 μ A	
	2.2 A to 11 A	5 kHz to 10 kHz	0.7 % + 160 μ A	
		40 Hz to 1 kHz	0.05 % + 170 μ A	Fluke 5720A+5725A
		1 kHz to 5 kHz	0.10 % + 380 μ A	
		5 kHz to 10 kHz	0.36 % + 750 μ A	
	11 A to 20.5 A	45 Hz to 1 kHz	0.09 % + 2 mA	Fluke 5520A
		1 kHz to 5 kHz	2.3 % + 5 mA	
	20 A to 150 A	45 Hz to 65 Hz	0.34 % + 26 mA	Fluke 5520A
		65 Hz to 440 Hz	0.95 % + 47 mA	
		45 Hz to 65 Hz	0.38 % + 0.12 A	
		65 Hz to 440 Hz	1.2 % + 0.22 A	
Clamp-on Ammeter Non-Toroidal Type Field calibrations Available <small>Note 4</small>	20 A to 150 A	45 Hz to 65 Hz	0.65 % + 0.25 A	Fluke 5520A
		65 Hz to 440 Hz	1.2 % + 0.25 A	
		45 Hz to 65 Hz	0.68 % + 0.9 A	
		65 Hz to 440 Hz	1.4 % + 0.92 A	

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Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ($k=2$) <small>Note 3,5</small>	Remarks
AC Current – Measure Field calibrations Available <small>Note 4</small>	0 μA to 100 μA	10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 1 kHz	0.46 % + 30 nA 0.18 % + 30 nA 0.072 % + 30 nA 0.072 % + 30 nA	Agilent 3458A opt 2
	0.1 mA to 1 mA	10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 1 kHz	0.46 % + 200 nA 0.17 % + 200 nA 0.071 % + 200 nA 0.037 % + 200 nA	
	1 mA to 10 mA	10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 1 kHz	0.46 % + 2 μA 0.17 % + 2 μA 0.071 % + 2 μA 0.038 % + 2 μA	
	10 mA to 100 mA	10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 1 kHz	0.46 % + 20 μA 0.17 % + 20 μA 0.071 % + 20 μA 0.037 % + 20 μA	
	0.1 A to 1 A	10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 1 kHz	0.46 % + 200 μA 0.19 % + 200 μA 0.097 % + 200 μA 0.12 % + 200 μA	

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ($k=2$) <small>Note 3,5</small>	Remarks
DC RESISTANCE AND CURRENT (20/E05)			
DC Resistance – Measuring Equipment and Measure	0 Ω (floor) 100 μΩ to < 1 mΩ 1 mΩ to < 10 mΩ 10 mΩ to < 100 mΩ 0.1 Ω to < 1 Ω	0.63 nΩ 6.3 μΩ/Ω 3.0 μΩ/Ω 2.3 μΩ/Ω 2.3 μΩ/Ω	Standard Resistors with Current Source and DMM

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ($k=2$) <small>Note 3,5</small>	Remarks
DC Resistance – Measure	1 Ω to < 10 Ω 10 Ω to < 100 Ω 100 Ω to < 1 kΩ 1 kΩ to < 10 kΩ 10 kΩ to < 100 kΩ 100 kΩ to < 1 MΩ 1 MΩ to < 10 MΩ 10 MΩ to < 100 MΩ 100 MΩ to < 1 GΩ 1 GΩ to < 20 GΩ	0.18 μΩ/Ω 0.29 μΩ/Ω 0.28 μΩ/Ω 0.44 μΩ/Ω 0.19 μΩ/Ω 1.7 μΩ/Ω 5.7 μΩ/Ω 11 μΩ/Ω 29 μΩ/Ω 130 μΩ/Ω	Standard Resistors with MI 6242B Bridge Standard Resistor Standard Resistors with 8508 (Double Substitution)
Resistance Ratio	100 MΩ Source 1 GΩ Source	24 μΩ/Ω 38 μΩ/Ω	Standard Resistor
DC Resistance – Measuring Equipment and Measure Field calibrations Available <small>Note 4</small>	1 Ω to 1 kΩ	0.2 μΩ/Ω	MI 6242B Bridge
DC Resistance – Measuring Equipment Field calibrations Available <small>Note 4</small>	10 mΩ to 10 Ω 10 Ω to 100 Ω 100 Ω to 1 kΩ 1 kΩ to 10 kΩ 10 kΩ to 100 kΩ 100 kΩ to 1 MΩ 1 MΩ to 10 MΩ 10 MΩ to 100 MΩ 100 MΩ to 1 GΩ	18 μΩ/Ω + 50 μΩ 15 μΩ/Ω + 500 μΩ 12 μΩ/Ω + 500 μΩ 12 μΩ/Ω + 5 mΩ 12 μΩ/Ω + 50 mΩ 19 μΩ/Ω + 2 Ω 62 μΩ/Ω + 100 Ω 590 μΩ/Ω + 1 kΩ 0.58 % + 10 kΩ	HP3458A with Decade Resistor
DC Resistance – Measuring Equipment Field calibrations Available <small>Note 4</small>	10 MΩ to 100 MΩ 100 MΩ to 1 GΩ 1 GΩ to 10 GΩ 10 GΩ to 100 GΩ 100 GΩ to 1 TΩ	0.08 % 0.25 % 0.41 % 0.84 % 2.5 %	IET HRRS-B-7-100k-5kV

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Measured Parameter or Device Calibrated	Range	Uncertainty ($k=2$) <small>Note 3,5</small>	Remarks
DC Current – Measuring Equipment and Measure	0 A (floor) 100 μ A to < 1 mA 1 mA to < 10 mA 10 mA to < 100 mA 100 mA to < 1 A 1 A to < 10 A 10 A to < 20 A 20 A > 20 A to 100 A	0.40 nA 4.5 μ A/A 2.0 μ A/A 1.9 μ A/A 2.2 μ A/A 3.3 μ A/A 6.9 μ A/A 61 μ A/A 78 μ A/A	Standard Shunts with Current Source
DC Current – Measuring Equipment and Measure Field calibrations Available <small>Note 4</small>	0 μ A to 100 μ A 100 μ A to 1 mA 1 mA to 10 mA 10 mA to 100 mA 100 mA to 1 A 1 A to 20 A	26 μ A/A + 0.8 nA 26 μ A/A + 5 nA 26 μ A/A + 50 nA 43 μ A/A + 500 nA 130 μ A/A + 10 μ A 230 μ A/A + 750 μ A	HP3458A with Current Source
Clamp-on Ammeter Non-Toroidal Type Field calibrations Available <small>Note 4</small>	20 A to 150 A 150 A to 1000 A	0.5 % + 0.14 A 0.52 % + 0.5 A	Fluke 5520A with Current Source 5520A/Coil
DC VOLTAGE (20/E06)			
DC Voltage – Fixed Points Measuring Equipment and Measure	0 V (floor) 1 mV 10 mV 100 mV 1 V 10 V 19 V 100 V 1000 V 20 mV to < 50 mV	59 nV 120 μ V/V 22 μ V/V 0.80 μ V/V 0.29 μ V/V 0.20 μ V/V 0.48 μ V/V 0.28 μ V/V 0.54 μ V/V 13 μ V/V + 0.059 μ V	Ratio Metric with Zener Reference

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Measured Parameter or Device Calibrated	Range	Uncertainty ($k=2$) <small>Note 3,5</small>	Remarks
	50 mV to < 100 mV 100 mV to \leq 1 kV > 1.1 kV to 5 kV > 5 kV to 120 kV	7.3 μ V/V + 0.059 μ V 0.61 μ V/V + 0.059 μ V 96 μ V/V 110 μ V/V	High Voltage Divider Comparison
DC Voltage – Measuring Equipment and Measure Field calibrations Available <small>Note 4</small>	0 V to 100 mV 100 mV to 10 V 10 V to 100 V 100 V to 500 V 500 V to 800 V 800 V to 1100 V	7.1 μ V/V + 0.5 μ V 5 μ V/V + 0.5 μ V 7.6 μ V/V + 30 μ V 11 μ V/V + 100 μ V 16 μ V/V + 100 μ V 21 μ V/V + 100 μ V	HP3458A opt 2 with 5720A

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Remarks																									
LOW FREQUENCY AC VOLTAGE (20/E09)																										
AC Voltage – Measure	Fluke 792A																									
Uncertainty ($k=2$) in μV/V <small>Note 3</small>																										
Frequency Range																										
Range	10 Hz	20 Hz	40 Hz	100 Hz	1 kHz	10 kHz	20 kHz	50 kHz	100 kHz	300 kHz	500 kHz	800 kHz	1 MHz													
2 mV	630	880	920	910	370	830	830	420	1000	1200	2000	2400	2400													
6 mV	320	300	330	200	260	250	270	330	530	760	920	600	660													
10 mV	140	190	110	230	180	190	160	210	290	230	640	390	490													
20 mV	82	73	63	110	73	84	62	140	200	300	460	340	390													
60 mV	100	66	52	45	37	47	52	70	130	270	350	410	420													
100 mV	38	35	22	32	30	34	31	41	76	150	200	270	210													
200 mV	42	24	38	23	19	25	18	45	87	130	110	250	200													
600 mV	30	39	17	11	12	11	12	22	31	96	90	86	110													
1 V	86	35	18	9.2	9.4	11	7.7	18	10	70	95	95	75													
2 V	25	20	18	8.0	6.9	6.5	7.1	15	11	96	95	76	76													
6 V	33	21	18	8.9	6.8	8.2	7.0	21	12	92	93	78	78													

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Measured Parameter or Device Calibrated	Remarks																									
LOW FREQUENCY AC VOLTAGE (20/E09)																										
AC Voltage – Measure	Fluke 792A																									
Uncertainty (<i>k</i>=2) in $\mu\text{V}/\text{V}$^{Note 3}																										
Frequency Range																										
Range	10 Hz	20 Hz	40 Hz	100 Hz	1 kHz	10 kHz	20 kHz	50 kHz	100 kHz	300 kHz	500 kHz	800 kHz	1 MHz													
10 V	20	32	18	9.8	8.3	8.3	9.3	10	11	70	99	100	120													
20 V	37	21	19	8.9	8.5	8.9	9.7	11	15	85	91	78	82													
60 V	37	23	19	11	11	12	11	33	16	73																
100 V	86	35	19	15	14	15	11	31	16																	
200 V	44	24	19	18	12	12	13	17	21																	
600 V	96	47	27	23	16	16	17	46	51																	
1000 V	54	21	22	22	19	18	20	49	52																	

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

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (<i>k</i> =2) ^{Note 3,5}	Remarks
AC High Voltage	700 V to 2 kV 2 kV to 10 kV 10 kV to 80 kV	60 Hz	0.05 % + 1.6 0.11 % + 0.4 0.114 %	HV Divider Comparison
AC Voltage – Measure Field calibrations Available ^{Note 4}	0 mV to 10 mV 10 mV to 100 mV	1 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 1 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 50 kHz	0.039 % + 3 μV 0.028 % + 1 μV 0.038 % + 1 μV 0.15 % + 1 μV 0.59 % + 1 μV 4.6 % + 2 μV 0.013 % + 4 μV 0.0094 % + 2 μV 0.017 % + 2 μV 0.037 % + 2 μV	Agilent 3458A opt 2

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Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ($k=2$) <small>Note 3,5</small>	Remarks
AC Voltage – Measuring Equipment <small>Field calibrations Available ^{Note 4}</small>	100 mV to 1 V	50 kHz to 100 kHz	0.093 % + 2 μ V	
		100 kHz to 300 kHz	0.36 % + 10 μ V	
		300 kHz to 1 MHz	1.2 % + 10 μ V	
		1 Hz to 40 Hz	0.0098 % + 40 μ V	
		40 Hz to 1 kHz	0.0094 % + 20 μ V	
		1 kHz to 20 kHz	0.017 % + 20 μ V	
		20 kHz to 50 kHz	0.036 % + 20 μ V	
	1 V to 10 V	50 kHz to 100 kHz	0.093 % + 20 μ V	
		100 kHz to 300 kHz	0.35 % + 100 μ V	
		300 kHz to 1 MHz	1.2 % + 100 μ V	
	10 V to 100 V	1 Hz to 40 Hz	0.0095 % + 0.4 mV	
		40 Hz to 1 kHz	0.0095 % + 0.2 mV	
		1 kHz to 20 kHz	0.017 % + 0.2 mV	
		20 kHz to 50 kHz	0.036 % + 0.2 mV	
		50 kHz to 100 kHz	0.093 % + 0.2 mV	
		100 kHz to 300 kHz	0.35 % + 1 mV	
		300 kHz to 1 MHz	1.2 % + 1 mV	
	100 V to 700 V	1 Hz to 40 Hz	0.024 % + 4 mV	
		40 Hz to 1 kHz	0.024 % + 2 mV	
		1 kHz to 20 kHz	0.024 % + 2 mV	
		20 kHz to 50 kHz	0.041 % + 2 mV	
		50 kHz to 100 kHz	0.14 % + 2 mV	
	0 mV to 2.2 mV	100 kHz to 300 kHz	0.46 % + 10 mV	
		300 kHz to 1 MHz	1.7 % + 10 mV	
	1 Hz to 40 Hz	1 Hz to 40 Hz	0.047 % + 40 mV	
		40 Hz to 1 kHz	0.047 % + 20 mV	
		1 kHz to 20 kHz	0.071 % + 20 mV	
		20 kHz to 50 kHz	0.14 % + 20 mV	
		50 kHz to 100 kHz	0.35 % + 20 mV	
	10 Hz to 20 Hz	10 Hz to 20 Hz	0.16 % + 4 μ V	
		20 Hz to 40 Hz	0.1 % + 4 μ V	Fluke 5720A

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Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ($k=2$) <small>Note 3,5</small>	Remarks
		40 Hz to 20 kHz	0.077% + 4 μ V	
		20 kHz to 50 kHz	0.12 % + 4.5 μ V	
		50 kHz to 100 kHz	0.17 % + 5 μ V	
		100 kHz to 300 kHz	0.33 % + 10 μ V	
		300 kHz to 500 kHz	0.47 % + 20 μ V	
		500 kHz to 1 MHz	0.58 % + 20 μ V	
	2.2 mV to 22 mV	10 Hz to 20 Hz	0.044 % + 4 μ V	
		20 Hz to 40 Hz	0.031 % + 4 μ V	
		40 Hz to 20 kHz	0.015 % + 4 μ V	
		20 kHz to 50 kHz	0.031 % + 4 μ V	
		50 kHz to 100 kHz	0.059 % + 5 μ V	
		100 kHz to 300 kHz	0.12 % + 12 μ V	
		300 kHz to 500 kHz	0.16 % + 20 μ V	
		500 kHz to 1 MHz	0.3 % + 20 μ V	
	22 mV to 220 mV	10 Hz to 20 Hz	0.028 % + 12 μ V	
		20 Hz to 40 Hz	0.011 % + 7 μ V	
		40 Hz to 20 kHz	0.0083 % + 7 μ V	
		20 kHz to 50 kHz	0.021 % + 7 μ V	
		50 kHz to 100 kHz	0.047 % + 17 μ V	
		100 kHz to 300 kHz	0.092 % + 20 μ V	
		300 kHz to 500 kHz	0.14 % + 25 μ V	
		500 kHz to 1 MHz	0.28 % + 45 μ V	
	220 mV to 2.2 V	10 Hz to 20 Hz	0.028 % + 40 μ V	
		20 Hz to 40 Hz	0.01 % + 15 μ V	
		40 Hz to 20 kHz	0.0048 % + 8 μ V	
		20 kHz to 50 kHz	0.0081 % + 10 μ V	
		50 kHz to 100 kHz	0.012 % + 30 μ V	
		100 kHz to 300 kHz	0.043 % + 80 μ V	
		300 kHz to 500 kHz	0.1 % + 200 μ V	
		500 kHz to 1 MHz	0.18 % + 300 μ V	
	2.2 V to 22 V	10 Hz to 20 Hz	0.028 % + 0.4 mV	
		20 Hz to 40 Hz	0.01 % + 0.15 mV	
		40 Hz to 20 kHz	0.0049 % + 50 μ V	

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		20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	0.0083 % + 0.1 mV 0.011 % + 0.2 mV 0.03 % + 0.6 mV 0.10 % + 2 mV 0.17 % + 3.2 mV	
	22 V to 220 V	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	0.028 % + 4 mV 0.01 % + 1.5 mV 0.0056 % + 0.6 mV 0.0093 % + 1 mV 0.016 % + 2.5 mV 0.085 % + 16 mV 0.44 % + 40 mV 0.8 % + 40 mV	
	220 V to 1100 V	40 Hz to 1 kHz 1 kHz to 30 kHz	0.011 % + 4 mV 0.017 % + 6 mV	Fluke 5720A/5725A
	220 V to 750 V	30 kHz to 50 kHz 50 kHz to 100 kHz	0.061 % + 11 mV 0.23 % + 45 mV	

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ($k=2$) <small>Note 3</small>	Remarks
LOW FREQUENCY CAPACITANCE (20/E10)			
Capacitance – Source: 1 kHz	0.01 pF 0.1 pF 1 pF 10 pF 100 pF 500 pF 1 nF 10 nF 200 nF	0.02 % + 30 aF 0.02 % + 30 aF 0.02 % 0.02 % 0.02 % 0.02 % 0.002 % 0.02 % 0.02 %	Fixed Capacitors with GR1615-A Bridge

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ($k=2$) <small>Note 3</small>	Remarks
Capacitance – Measure:	1 aF to 1.1 µF	0.012 % + 30 aF	GR1615-A Bridge
50 Hz to 1 MHz	1.1 µF to 10 mF	0.06 % + 30 aF	Quadtech 7600LCR Bridge
	0.33 mF	0.048 %	Time/Charge Method with HP3458A
	0.8 mF	0.027 %	
	1 mF	0.024 %	
	1.2 mF	0.023 %	
	3 mF	0.018 %	
	3.3 mF	0.017 %	
	8 mF	0.016 %	
	10 mF	0.016 %	
	12 mF	0.016 %	
	30 mF	0.015 %	
	80 mF	0.014 %	
	100 mF	0.014 %	

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ($k=2$) <small>Note 3,5</small>	Remarks
Capacitance – Measuring Equipment	0.19 nF to 1.1 nF	10 Hz to 10 kHz	0.39 % + 7.8 pF	Fluke 5520A
Field calibrations Available <small>Note 4</small>	1.1 nF to 3.3 nF	10 Hz to 3 kHz	0.39 % + 7.8 pF	
	3.3 nF to 11 nF	10 Hz to 1 kHz	0.21 % + 7.8 pF	
	11 nF to 110 nF	10 Hz to 1 kHz	0.21 % + 78 pF	
	110 nF to 330 nF	10 Hz to 1 kHz	0.21 % + 0.23 nF	
	0.33 µF to 1.1 µF	10 Hz to 600 Hz	0.20 % + 0.78 nF	
	1.1 µF to 3.3 µF	10 Hz to 300 Hz	0.20 % + 2.3 nF	
	3.3 µF to 11 µF	10 Hz to 150 Hz	0.20 % + 7.8 nF	
	11 µF to 33 µF	10 Hz to 120 Hz	0.31 % + 23 nF	
	33 µF to 110 µF	10 Hz to 80 Hz	0.35 % + 78 nF	
	110 µF to 330 µF	DC to 50 Hz	0.35 % + 0.23 µF	
	0.33 mF to 1.1 mF	DC to 20 Hz	0.35 % + 0.78 µF	
	1.1 mF to 3.3 mF	DC to 6 Hz	0.35 % + 2.3 µF	
	3.3 mF to 11 mF	DC to 2 Hz	0.35 % + 7.8 µF	

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ($k=2$) <small>Note 3,5</small>	Remarks
	11 mF to 33 mF 33 mF to 110 mF	DC to 0.6 Hz DC to 0.2 Hz	0.58 % + 23 μ F 0.85 % + 78 μ F	

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ($k=2$) <small>Note 3,5</small>	Remarks
LOW FREQUENCY INDUCTANCE (20/E11)			
Inductance – Source Field calibrations Available <small>Note 4</small>	100 mH	0.07 %	Fixed Inductors with Quadtech 7600
Inductance – Measure: 1 kHz Field calibrations Available <small>Note 4</small>	10 μ H to 100 H	0.07 %	Quadtech 7600

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ($k=2$) <small>Note 3,5</small>	Remarks
LF POWER/ENERGY (20/E12)				
Power – Measuring Equipment DC Power 0.33 mA to 330 mA	11 μ W to 1.1 mW 1.1 mW to 110 mW 0.11W to 110 W 110 W to 330 W	DC DC DC DC	0.024 % 0.027 % 0.024 % 0.018 %	Fluke 5520A
0.33 A to 3 A	11 W to 110 mW 0.11 W to 990 W 1 W to 3 kW	DC DC DC	0.044 % 0.053 % 0.0096 %	
3 A to 20.5 A	0.099 W to 0.99 W 0.99 W to 6.8 kW 6.8 W to 20.5 kW	DC DC DC	0.088 % 0.07 % 0.04 %	
AC Power <small>Note 8</small> (PF = 1) 3.3 mA to 9 mA	0.11 mW to 3 mW	10 Hz to 65 Hz	0.13 %	

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Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ($k=2$) <small>Note 3,5</small>	Remarks
9 mA to 33 mA	3 mW to 9 W	10 Hz to 65 Hz	0.077 %	
	0.3 mW to 10 mW 10 mW to 33 W	10 Hz to 65 Hz 10 Hz to 65 Hz	0.089 % 0.077 %	
33 mA to 90 mA	1 mW to 30 mW 30 mW to 90 W	10 Hz to 65 Hz 10 Hz to 65 Hz	0.071 % 0.057 %	
	3.0 mW to 100 mW 100 mW to 300 W	10 Hz to 65 Hz 10 Hz to 65 Hz	0.089 % 0.078 %	
0.33 A to 0.9 A	11 mW to 300 mW 300 mW to 900 W	10 Hz to 65 Hz 10 Hz to 65 Hz	0.071 % 0.081 %	
	30 mW to 720 mW 720 mW to 2 kW	10 Hz to 65 Hz 10 Hz to 65 Hz	0.089 % 0.079 %	
2.2 A to 4.5 A	80 mW to 1.4 W 1.4 W to 4.5 kW	10 Hz to 65 Hz 10 Hz to 65 Hz	0.088 % 0.18 %	
	150 mW to 6.7 W 6.7 W to 20 kW	10 Hz to 65 Hz 10 Hz to 65 Hz	0.17 % 0.17 %	

PHASE METERS (20/E15)

AC Phase – Measure	0° to 360°	1 Hz to 1 kHz > 1 kHz to 50 kHz > 50 kHz to 200 kHz	7.2" 15" 36"	Clark-Hess 5002 Bridge Set
AC Phase – Generate: 50 mV to < 100 V	0° to 360°	1 Hz to 1 kHz > 1 kHz to 6.25 kHz > 6.25 kHz to 50 kHz > 50 kHz to 200 kHz	47" 61" 76" 180"	Clark-Hess 5500-2 Phase Standard
100 V to 120 V	0° to 360°	1 Hz to 1 kHz > 1 kHz to 6.25 kHz > 6.25 kHz to 50 kHz > 50 kHz to 200 kHz	61" 94" 130" 340"	

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

Measured Parameter or Device Calibrated	Range	Uncertainty ($k=2$) ^{Note 3,5}	Remarks
TIME AND FREQUENCY			
FREQUENCY DISSEMINATION (20/F01)			
Frequency – Source and Measure	10 MHz	Uncertainty values of derivatives of 10 MHz will differ due to resolution, noise and gating errors. 5.8×10^{-10} Hz	Rubidium Frequency Standard
PULSE WAVEFORM (20/F04)			
Rise time (Generate)	≥ 14 ps	2 ps	Pulser
Rise time (Measure)	28 ps to 300 ps 300 ps to 5 ns 5 ns to 100 ns 100 ns	14 % 4.7 % 1.4 % 0.73 %	Sampling System
MECHANICAL			
MASS (20/M08)			
Mass – Metric Field calibrations Available ^{Note 4}	8 kg 7 kg 6 kg 5 kg 4 kg 2 kg 1 kg 500 g 200 g 100 g 50 g 20 g 10 g 5 g 2 g 1 g 500 mg	9.4 mg 8.9 mg 8.5 mg 7.9 mg 7.5 mg 4.0 mg 2.6 mg 1.0 mg 0.75 mg 0.38 mg 0.17 mg 0.30 mg 0.18 mg 0.20 mg 0.18 mg 0.15 mg 0.15 mg	Echelon III

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ($k=2$) <small>Note 3,5</small>	Remarks
	200 mg	0.14 mg	
	100 mg	0.14 mg	
	50 mg	0.14 mg	
	20 mg	0.14 mg	
	10 mg	0.16 mg	
	5 mg	0.14 mg	
	2 mg	0.14 mg	
	1 mg	0.14 mg	
TORQUE (20/M15)			
Torque Measure Field calibrations Available <small>Note 4</small>	10 lbf-in to 600 lbf-ft	1.0 %	CDI Torque system
ELECTROMAGNETICS – RF/MICROWAVE			
HIGH FREQUENCY RESISTORS (20/R07)			
Impedance: 10 Hz to 1 MHz Field calibrations Available <small>Note 4</small>	1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ	0.059 % 0.059 % 0.059 % 0.059 % 0.062 % 0.19 %	Quadtech 7600 LCR Meter

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Remarks							
RF – DC VOLTAGE/ CURRENT CONVERTERS (20/R11)								
Flatness Relative to 1 kHz Field calibrations Available <small>Note 4</small>	Uncertainty ($k=2$) in % <small>Note 3,5</small>							
	Range							
Frequency Range	7 V	2.2 V	700 mV	220 mV	70 mV	22 mV	7 mV	2.2 mV
10 Hz	0.006	0.01	0.01	0.015	0.017	0.019	0.02	0.022
20 Hz	0.007	0.011	0.011	0.015	0.017	0.019	0.02	0.022
50 Hz	0.005	0.006	0.006	0.007	0.008	0.008	0.009	0.009
105 Hz	0.007	0.007	0.007	0.008	0.009	0.009	0.010	0.010
200 Hz	0.005	0.006	0.006	0.007	0.008	0.008	0.009	0.009

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Remarks															
RF – DC VOLTAGE/ CURRENT CONVERTERS (20/R11)																
Flatness Relative to 1 kHz																
Field calibrations Available <small>Note 4</small>																
Frequency Range	Uncertainty ($k=2$) in % <small>Note 3,5</small>															
	Range															
	7 V	2.2 V	700 mV	220 mV	70 mV	22 mV	7 mV	2.2 mV								
2 kHz	0.005	0.006	0.006	0.007	0.008	0.008	0.009	0.009								
10 kHz	0.006	0.006	0.006	0.007	0.008	0.008	0.009	0.009								
20 kHz	0.005	0.006	0.006	0.007	0.008	0.008	0.009	0.009								
50 kHz	0.006	0.006	0.006	0.007	0.008	0.008	0.009	0.009								
100 kHz	0.005	0.006	0.006	0.007	0.008	0.008	0.009	0.009								
200 kHz	0.006	0.006	0.006	0.007	0.008	0.008	0.009	0.009								
500 kHz	0.005	0.006	0.006	0.007	0.008	0.008	0.009	0.009								
700 kHz	0.011	0.012	0.012	0.013	0.014	0.014	0.015	0.016								
1 MHz	0.011	0.012	0.013	0.014	0.014	0.015	0.015	0.016								
1.2 MHz	0.012	0.013	0.014	0.014	0.014	0.015	0.016	0.016								
2 MHz	0.014	0.015	0.016	0.016	0.016	0.017	0.018	0.018								
3 MHz	0.017	0.019	0.02	0.021	0.022	0.023	0.023	0.025								
4 MHz	0.019	0.02	0.022	0.022	0.023	0.024	0.024	0.025								
6 MHz	0.023	0.025	0.027	0.028	0.028	0.03	0.031	0.032								
8 MHz	0.028	0.029	0.031	0.032	0.032	0.034	0.034	0.036								
9 MHz	0.027	0.029	0.03	0.031	0.032	0.033	0.034	0.035								
10 MHz	0.026	0.029	0.031	0.030	0.031	0.032	0.033	0.035								
12 MHz	0.036	0.039	0.041	0.042	0.043	0.045	0.046	0.048								
15 MHz	0.037	0.04	0.042	0.042	0.043	0.046	0.047	0.049								
17 MHz	0.042	0.045	0.047	0.047	0.048	0.050	0.050	0.052								
20 MHz	0.045	0.048	0.051	0.052	0.054	0.057	0.059	0.061								
23 MHz	0.068	0.070	0.073	0.074	0.076	0.079	0.081	0.084								
26 MHz	0.083	0.084	0.087	0.09	0.093	0.096	0.098	0.10								
28 MHz	0.094	0.096	0.10	0.10	0.11	0.11	0.12	0.12								
30 MHz	0.11	0.11	0.11	0.11	0.12	0.12	0.12	0.13								

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ($k=2$) <small>Note 3</small>	Remarks
RF/MICROWAVE ATTENUATORS (20/R13)			
Attenuation: 2.5 MHz to 26.5 GHz	0 dB to -10 dB -10 dB to -20 dB -20 dB to -30 dB -30 dB to -40 dB -40 dB to -50 dB -50 dB to -60 dB -60 dB to -70 dB -70 dB to -80 dB -80 dB to -90 dB -90 dB to -100 dB -100 dB to -110 dB -110 dB to -120 dB	0.02 dB + M 0.021 dB + M 0.025 dB + M 0.029 dB + M 0.034 dB + M 0.039 dB + M 0.043 dB + M 0.052 dB + M 0.056 dB + M 0.06 dB + M 0.12 dB + M 0.18 dB + M	Where M is mismatch uncertainty at time of test. Agilent 8902 with 11793A sensor

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ($k=2$) <small>Note 3</small>	Remarks
RF/MICROWAVE POWER METERS (20/R17)				
RF Power Field calibrations Available <small>Note 4</small>	+30 dBm to -20 dBm -20 dBm to -40 dBm	100 kHz to 2.6 GHz 2.6 GHz to 26.5 GHz 9 kHz to 6 GHz	0.11 dBm + M 0.16 dBm + M 0.18 dBm + M	Measuring Receiver Power Meter with sensor
Total Harmonic Distortion: 50 Ω and 600 Ω	0 dB	20 Hz to 100 kHz	3.1 dB	8903B
AM Total Harmonic Distortion	0 dB	20 Hz to 100 kHz	3.1 dB	8903B/8902A
Harmonic Distortion	0 dB	100 kHz to 2.9 GHz 2.9 GHz to 6.5 GHz 6.5 GHz to 13.2 GHz 13.2 GHz to 22 GHz	1.7 dB 1.9 dB 2.6 dB 3.7 dB	Spectrum Analyzer

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ($k=2$) <small>Note 3,5</small>	Remarks
THERMODYNAMIC			
LABORATORY THERMOMETERS (20/T03)			
Measuring Equipment	0 °C to 50 °C 50 °C to 400 °C 400 °C to 600 °C	0.007 °C 0.029 °C 0.24 °C	Liquid Bath with RTD Dry Block Calibrator
Measure Field calibrations Available <small>Note 4</small>	-195 °C to 0 °C 0 °C to 420 °C 420 °C to 660 °C	0.021 °C 0.025 °C 0.032 °C	PRT and Hart 1560
PRESSURE (20/T05)			
Absolute Pressure Source – Pneumatic	0.2 psia to 100 psia 100 psia to 1000 psia	0.0011 % + 0.07 mpsi 0.0015 %	Ruska 2465
Gage Pressure Source – Gage	-60 inH ₂ O to +60 inH ₂ O 2 psi to 100 psi 100 psi to 1000 psi	0.0028 % + 22 µinH ₂ O 0.0011 % 0.0015 %	DHI FPG 7601 Ruska 2465
Gage Pressure Source – Hydraulic	75 psi to 3000 psi 725 psi to 30 000 psi 30 000 psi to 72 500 psi	0.0016 % 0.005 % 0.010 %	DHI PG7000
Determination of Piston Area	0.2 psia to 100 psia 100 psia to 1000 psia 40 psia to 10 000 psia	0.0013 % 0.0016 % 0.0037 %	Ruska 2465 DHI 5300
Gage Pressure Source	0.5 psi to 500 psi	0.0065 %	Pressurements T2300
Hydraulic Field calibrations Available <small>Note 4</small>	500 psi to 15 000 psi	0.03 %	Ametek T-150

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Measured Parameter or Device Calibrated	Range	Uncertainty ($k=2$) <small>Note 3,5</small>	Remarks
THERMOCOUPLES & PYROMETER INDICATORS (20/T08)			
Isothermal Block Verification Field calibrations Available <small>Note 4</small>	Ambient (~ 23 °C)	0.04 °C	Thermocouple Half Junction
Type J	-210 °C to 1200 °C	0.1°C	Thermocouple Half Junction
Type K	-270 °C to 1372 °C	0.1°C	
Type T	-270 °C to 400 °C	0.1°C	
Type E	-270 °C to 1000 °C	0.1°C	
Type R	0 °C to 250 °C 250 °C to 400 °C 400 °C to 1000 °C 1000 °C to 1767 °C	0.58°C 0.36 °C 0.35 °C 0.47 °C	Fluke 5520A
Type S	0 °C to 250 °C 250 °C to 1000 °C 1000 °C to 1400 °C 1400 °C to 1767 °C	0.48 °C 0.37 °C 0.38 °C 0.47 °C	
Type N	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 410 °C	0.41 °C 0.24 °C 0.22 °C 0.21 °C	
Type B	410 °C to 1300 °C 600 °C to 800 °C 800 °C to 1000 °C 1000 °C to 1550 °C 1550 °C to 1820 °C	0.29 °C 0.45 °C 0.35 °C 0.32 °C 0.35 °C	

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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: The uncertainties shown are for the most favorable conditions. There is an increase in uncertainty that corresponds to the laboratory's AC voltage and current uncertainties at different frequencies other than the ones shown. Power factors (PF) other than the one shown contribute to the power uncertainty. PF is related to the cosine of phase. Therefore, uncertainties track the laboratory's phase uncertainty closely at PF near one, but are magnified heavily as PF approaches zero. The lab may also report reactive power, apparent power, and power factor under this accreditation. If needed, contact laboratory for more information regarding uncertainties at frequency and power factor combinations other than the ones shown.

Note 9: Where L is shown, it is the numeric value of the measured value in the same units expressed in the range.

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