National Voluntary Laboratory Accreditation Program

CALIBRATION LABORATORIES **NVLAP LAB CODE 200903-0**

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

Transcat – Charlotte	**Fields of Calibration**
8334 Arrowridge Blvd., Suite B Charlotte, NC 28273 Mr. Brian Samuelson Phone: 704-529-6154; Fax: 704-529-3590 E-mail: bsamuelson@transcat.com URL: http://www.transcat.com	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)

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	**Range**	**Uncertainty (*k*=2)** Note 3	**Remarks**
DIMENSIONAL			
ANGULAR (20/D01)			
Angles	0° to 75° 90°	5.3” 1.2”	Angle Blocks Master Square
GAGE BLOCKS (20/D03)			
Gage Blocks English Metric	 0.05 in to 1 in 1 in to 4 in 1 mm to 10 mm 10 mm to 100 mm	 1.5 µin + 1.4 µin/in 0.7 µin + 1.9 µin/in 0.032 µm + 3.0 µm/m 0.07 µm + 1.5 µm/m	Federal Comparator and Grade 1 Blocks
LENGTH and DIAMETER (20/D05)			
Micrometers and Calipers – Outside, Inside, Depth Field calibrations available Note 4	0 in to 8 in 8 in to 48 in	20 µin + 5 µin/in 13 µin + 7 µin/in	Comparison to Gage Blocks
Anvil Flatness Field calibrations available Note 4	0 in to 3 in	6.7 µin	Optical Flats
Length Measurement – Single Axis	0 in to 6 in 6 in to 10 in	9 µin + 4 µin/in 2 µin + 5 µin/in	Supermicrometer and Gage Blocks

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Measured Parameter or Device Calibrated	Range	Uncertainty (k=2) Note 3	Remarks
Outside Diameter – Cylindrical Gages	0.01 in to 1 in	33 µin	Laser Micrometer
Digital and Dial Indicators	0 in to 6 in	4 µin + 7 µin/in	Comparison to Gage Blocks
Height Measuring Equipment and Measure	0 in to 8 in 8 in to 44 in	30 µin + 2 µin/in 10 µin + 4 µin/in	Comparison to Gage Blocks
Parallelism & Straightness	0 in to 3 in 3 in to 24 in	20 µin + 3.2 µin/in 30 µin + 3.2 µin/in	Gage Amp & Surface Plate
Optical X-Y X Axis Y Axis	 0 in to 9 in 0 in to 4 in	 290 µin 290 µin	 Optical Comparator
Optical Area X Axis Y Axis Magnification X-Y Axis	 0.05 in to 12 in 0.05 in to 12 in 10x to 50x 0.05 in to 12 in	 200 µin 200 µin 310 µin 260 µin	 Glass Grid Cylindrical Square
SPHERICAL DIAMETER; PLUG/RING GAGES (20/D11)			
Outer Diameter – Plug Gages	0 in to 1 in	33 µin	Laser Micrometer
Laser Micrometers	0 in to 1 in	13 µin + 3.2 µin/in	Master Pins
SURVEYING RODS and TAPES (20/D13)			
Tapes and Rulers Field calibrations available Note 4	0 in to 96 in	0.002 in + 14 µin/in	Glass Scale

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Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (k=2) Note 3,5	Remarks
ELECTROMAGNETICS – DC/LOW FREQUENCY				
VOLTAGE/CURRENT CONVERTORS (to 100 MHz) (20/E01)				
Sine Wave Flatness Field calibrations available Note 4	0 V to 3 V	10 Hz to 1 MHz 1 MHz to 10 MHz 10 MHz to 30 MHz 30 MHz to 50 MHz 50 MHz to 80 MHz 80 MHz to 100 MHz	0.052 % 0.095 % 0.18 % 0.41 % 0.71 % 0.84 %	Ballantine 1395B
AC RESISTORS and CURRENT (20/E02)				
AC Current – Measuring Equipment Field calibrations available Note 4	0 µA to 220 µA	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	0.028 % + 16 nA 0.019 % + 10 nA 0.014 % + 8.0 nA 0.030 % + 12 nA 0.11 % + 65 nA	Fluke 5700A-EP
	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	0.027 % + 40 nA 0.017 % + 35 nA 0.014 % + 35 nA 0.021 % + 110 nA 0.11 % + 650 nA	
	2.2 mA to 22 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	0.028 % + 400 nA 0.018 % + 350 nA 0.014 % + 350 nA 0.021 % + 550 nA 0.11 % + 5 µA	
	22 mA to 220 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	0.028 % + 4 µA 0.018 % + 3.5 µA 0.014 % + 2.5 µA 0.022 % + 3.5 µA 0.11 % + 10 µA	
	0.22 A to 2.2 A	20 Hz to 1 kHz 1 kHz to 5 kHz	0.027 % + 35 µA 0.047 % + 80 µA	

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Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (k=2) Note 3,5	Remarks
		5 kHz to 10 kHz	0.71 % + 160 µA	
	2.2 A to 11 A	20 Hz to 1 kHz	0.027 % + 170 µA	Fluke 5700A-EP with 5725A
		1 kHz to 5 kHz	0.098 % + 380 µA	
		5 kHz to 10 kHz	0.37 % + 750 µA	
	11 A to 20.5 A	45 Hz to 100 Hz	0.095 % + 3.9 mA	Fluke 5520A
		100 Hz to 1 kHz	0.12 % + 3.9 mA	
		1 kHz to 5 kHz	2.3 % + 3.9 mA	
	20 A to 100 A	50 Hz to 1 kHz	0.12 % + 0.30 mA	Ballantine 1625A
Extended Frequency Ranges Field calibrations available Note 4	29 µA to 330 µA	10 kHz to 30 kHz	1.2 % + 0.31 µA	Fluke 5520A
	330 µA to 3.3 mA	10 kHz to 30 kHz	0.78 % + 0.47 µA	
	3.3 mA to 33 mA	10 kHz to 30 kHz	0.31 % + 3.1 µA	
	33 mA to 330 mA	10 kHz to 30 kHz	0.31 % + 0.16 mA	
Clamp-on Ammeter Toroidal Type Field calibrations available Note 4	20 A to 150 A	45 Hz to 65 Hz	0.30 % + 26 mA	Fluke 5520A with 5500A/Coil
	20 A to 150 A	65 Hz to 440 Hz	0.83 % + 47 mA	
	150 A to 1000 A	45 Hz to 65 Hz	0.35 % + 0.12 A	
	150 A to 1000 A	65 Hz to 440 Hz	1.1 % + 0.22 A	
Clamp-on Ammeter Non-Toroidal Type Field calibrations available Note 4	20 A to 150 A	45 Hz to 65 Hz	0.57 % + 0.25 A	Fluke 5520A with 5500A/Coil
	20 A to 150 A	65 Hz to 440 Hz	1.0 % + 0.25 A	
	150 A to 1000 A	45 Hz to 65 Hz	0.60 % + 0.90 A	
	150 A to 1000 A	65 Hz to 440 Hz	1.3 % + 0.92 A	
AC Current – Measure Field calibrations available Note 4	0 µA to 100 µA	10 Hz to 20 Hz	0.46 % + 30 nA	Agilent 3458A opt 002
		20 Hz to 45 Hz	0.17 % + 30 nA	
		45 Hz to 100 Hz	0.072 % + 30 nA	
		100 Hz to 5 kHz	0.072 % + 30 nA	
	100 µA to 1 mA	10 Hz to 20 Hz	0.46 % + 200 nA	
		20 Hz to 45 Hz	0.17 % + 200 nA	
		45 Hz to 100 Hz	0.071 % + 200 nA	
		100 Hz to 5 kHz	0.038 % + 200 nA	

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Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (k=2) Note 3,5	Remarks
	1 mA to 10 mA	10 Hz to 20 Hz	0.46 % + 2 µA	
		20 Hz to 45 Hz	0.17 % + 2 µA	
		45 Hz to 100 Hz	0.071 % + 2 µA	
		100 Hz to 5 kHz	0.038 % + 2 µA	
	10 mA to 100 mA	10 Hz to 20 Hz	0.46 % + 20 µA	
		20 Hz to 45 Hz	0.17 % + 20 µA	
		45 Hz to 100 Hz	0.071 % + 20 µA	
		100 Hz to 5 kHz	0.037 % + 20 µA	
	100 mA to 1 A	10 Hz to 20 Hz	0.46 % + 0.20 mA	
		20 Hz to 45 Hz	0.19 % + 0.20 mA	
		45 Hz to 100 Hz	0.097 % + 0.20 mA	
		100 Hz to 5 kHz	0.12 % + 0.20 mA	
	1 A to 2 A	50 Hz to 1 kHz	0.12 % + 0.20 mA	Ballantine 1625A with Agilent 3458A
	2 A to 20 A	50 Hz to 1 kHz	0.12 % + 0.30 mA	
	20 A to 100 A	50 Hz to 1 kHz	0.12 % + 0.30 mA	

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty (k=2) Note 3,5	Remarks
DC RESISTANCE and CURRENT (20/E05)			
DC Resistance – Measuring Equipment and Measure Field calibrations available Note 4	0 Ω to 10 Ω	18 µΩ/Ω + 50 µΩ	HP 3458A with Decade Resistor
	10 Ω to 100 Ω	15 µΩ/Ω + 500 µΩ	
	100 Ω to 1 kΩ	12 µΩ/Ω + 500 µΩ	
	1 kΩ to 10 kΩ	12 µΩ/Ω + 5 mΩ	
	10 kΩ to 100 kΩ	12 µΩ/Ω + 50 mΩ	
	100 kΩ to 1 MΩ	19 µΩ/Ω + 2 Ω	
	1 MΩ to 10 MΩ	62 µΩ/Ω + 100 Ω	
	10 MΩ to 100 MΩ	590 µΩ/Ω + 1 kΩ	
	100 MΩ to 1 GΩ	0.58 % + 10 kΩ	
DC Resistance – Measuring Equipment	100 µΩ	810 µΩ/Ω	Fixed Resistors
	1 mΩ	500 µΩ/Ω	

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	10 mΩ	200 μΩ/Ω	
	100 mΩ	86 μΩ/Ω	
	1 Ω	100 μΩ/Ω	
	10 MΩ to 100 MΩ	0.08 %	IET HRRS-B-7-100k-5kV
	100 MΩ to 1 GΩ	0.24 %	
	1 GΩ to 10 GΩ	0.42 %	
	10 GΩ to 100 GΩ	0.83 %	
	100 GΩ to 1 TΩ	2.4 %	
DC Current – Measuring Equipment and Measure Field calibrations available Note 4	0 μA to 100 μA	26 μA/A + 0.8 nA	Agilent 3458A with Current Source
	100 μA to 1 mA	26 μA/A + 5 nA	
	1 mA to 10 mA	26 μA/A + 50 nA	
	10 mA to 100 mA	41 μA/A + 500 nA	
	100 mA to 1 A	130 μA/A + 10 μA	
DC Current – Measure Field calibrations available Note 4	1 A to 300 A	0.058 %	L&N 4363 shunt with DMM
DC Current – Measuring Equipment Field calibrations available Note 4	0.22 A to 2.2 A	92 μA/A + 12 μA	Fluke 5700A-EP With 5725A
	2.2 A to 11 A	280 μA/A + 480 μA	
	11 A to 20.5 A	780 μA/A + 750 μA	Fluke 5520A
Clamp-on Ammeter Non-Toroidal Type Field calibrations available Note 4	20 A to 150 A	0.50 % + 0.14 A	Fluke 5520A with 5500A/Coil
	150 A to 1000 A	0.51 % + 0.5 A	
DC VOLTAGE (20/E06)			
DC Voltage – Measure Field calibrations available Note 4	50 kV to 120 kV	0.083 %	High Voltage Divider
DC Voltage – Measuring Equipment Field calibrations available Note 4	0.22 V to 2.2 V	5.5 μV/V+ 0.7 μV	Fluke 5700A-EP
	2.2 V to 11 V	4.1 μV/V+ 2.5 μV	
	11 V to 22 V	4.0 μV/V+ 4.0 μV	
	22 V to 220 V	6.3 μV/V+ 40 μV	

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Measured Parameter or Device Calibrated	Range	Uncertainty (*k*=2) Note 3,5	Remarks
DC Voltage – Measure Equipment and Measure Field calibrations available Note 4	220 V to 1100 V	7.7 µV/V+ 400 µV	HP 3458A opt 002 with Fluke 5700A
	0 V to 100 mV	7.1 µV/V + 0.5 µV	
	100 mV to 10 V	5.0 µV/V + 0.5 µV	
	10 V to 100 V	7.6 µV/V + 30 µV	
	100 V to 500 V	11 µV/V + 100 µV	
	500 V to 800 V	14 µV/V + 100 µV	
	800 V to 1000 V	21 µV/V + 100 µV	
	1 kV to 2 kV	0.051 % + 0.4 V	Vitrek 4600A with source
	2 kV to 20 kV	0.049 % + 4.0 V	
	20 kV to 50 kV	0.082 %	HV Divider with source

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (*k*=2) Note 3,5	Remarks
LF AC VOLTAGE (20/E09)				
AC High Voltage – Measure Field calibrations available Note 4	700 V to 2 kV	20 Hz to 100 Hz	0.086 % + 2 V	Vitrek 4600A
	700 V to 2 kV	100 Hz to 400 Hz	0.53 % + 2 V	
	2 kV to 20 kV	20 Hz to 100 Hz	0.34 % + 20 V	
	20 kV to 85 kV	60 Hz	0.48 %	HV Voltage Divider
AC Voltage – Measure Field calibrations available Note 4	0 mV to 10 mV	1 Hz to 40 Hz	0.035 % + 3 µV	Agilent 3458A opt 002
		40 Hz to 1 kHz	0.026 % + 1.1 µV	
		1 kHz to 20 kHz	0.034 % + 1.1 µV	
		20 kHz to 50 kHz	0.10 % + 1.1 µV	
		50 kHz to 100 kHz	0.51 % + 1.1 µV	
		100 kHz to 300 kHz	4.0 % + 2 µV	
	10 mV to 100 mV	1 Hz to 40 Hz	0.012 % + 4 µV	
		40 Hz to 1 kHz	0.0085 % + 2 µV	
		1 kHz to 20 kHz	0.015 % + 2 µV	
		20 kHz to 50 kHz	0.030 % + 2 µV	
		50 kHz to 100 kHz	0.081 % + 2 µV	
		100 kHz to 300 kHz	0.31 % + 10 µV	
		300 kHz to 1 MHz	1.0 % + 10 µV	

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Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (k=2) Note 3,5	Remarks
	100 mV to 1 V	1 Hz to 40 Hz	0.0089 % + 40 µV	
		40 Hz to 1 kHz	0.0085 % + 20 µV	
		1 kHz to 20 kHz	0.015 % + 20 µV	
		20 kHz to 50 kHz	0.031 % + 20 µV	
		50 kHz to 100 kHz	0.081 % + 20 µV	
		100 kHz to 300 kHz	0.30 % + 100 µV	
		300 kHz to 1 MHz	1.0 % + 100 µV	
	1 V to 10 V	1 Hz to 40 Hz	0.0085 % + 0.4 mV	
		40 Hz to 1 kHz	0.0086 % + 0.2 mV	
		1 kHz to 20 kHz	0.015 % + 0.2 mV	
		20 kHz to 50 kHz	0.031 % + 0.2 mV	
		50 kHz to 100 kHz	0.081 % + 0.2 mV	
		100 kHz to 300 kHz	0.30 % + 1 mV	
		300 kHz to 1 MHz	1.0 % + 1 mV	
	10 V to 100 V	1 Hz to 40 Hz	0.021 % + 4 mV	
		40 Hz to 1 kHz	0.021 % + 2 mV	
		1 kHz to 20 kHz	0.021 % + 2 mV	
		20 kHz to 50 kHz	0.036 % + 2 mV	
		50 kHz to 100 kHz	0.12 % + 2 mV	
		100 kHz to 300 kHz	0.40 % + 10 mV	
		300 kHz to 1 MHz	1.5 % + 10 mV	
	100 V to 700 V	1 Hz to 40 Hz	0.041 % + 40 mV	
		40 Hz to 1 kHz	0.041 % + 20 mV	
		1 kHz to 20 kHz	0.061 % + 20 mV	
		20 kHz to 50 kHz	0.12 % + 20 mV	
		50 kHz to 100 kHz	0.35 % + 20 mV	
AC Voltage – Measuring Equipment Field calibrations available Note 4	0 mV to 2.2 mV	10 Hz to 20 Hz	0.036 % + 4 µV	Fluke 5700A-EP
		20 Hz to 40 Hz	0.033 % + 4 µV	
		40 Hz to 20 kHz	0.033 % + 4 µV	
		20 kHz to 50 kHz	0.033 % + 4 µV	
		50 kHz to 100 kHz	0.057 % + 5 µV	
		100 kHz to 300 kHz	0.13 % + 10 µV	

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Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (k=2) Note 3,5	Remarks
		300 kHz to 500 kHz	0.20 % + 20 µV	
		500 kHz to 1 MHz	0.31 % + 20 µV	
	2.2 mV to 22 mV	10 Hz to 20 Hz	0.044 % + 4 µV	
		20 Hz to 40 Hz	0.031 % + 4 µV	
		40 Hz to 20 kHz	0.015% + 4 µV	
		20 kHz to 50 kHz	0.032 % + 4 µV	
		50 kHz to 100 kHz	0.060 % + 5 µV	
		100 kHz to 300 kHz	0.066 % + 10 µV	
		300 kHz to 500 kHz	0.17 % + 20 µV	
		500 kHz to 1 MHz	0.31 % + 20 µV	
	22 mV to 220 mV	10 Hz to 20 Hz	0.029 % + 12 µV	
		20 Hz to 40 Hz	0.011 % + 7 µV	
		40 Hz to 20 kHz	0.0087 % + 7 µV	
		20 kHz to 50 kHz	0.021 % + 7 µV	
		50 kHz to 100 kHz	0.048 % + 17 µV	
		100 kHz to 300 kHz	0.094 % + 20 µV	
		300 kHz to 500 kHz	0.15 % + 25 µV	
		500 kHz to 1 MHz	0.28 % + 45 µV	
	220 mV to 2.2 V	10 Hz to 20 Hz	0.028 % + 40 µV	
		20 Hz to 40 Hz	0.010 % + 15 µV	
		40 Hz to 20 kHz	0.0049 % + 8 µV	
		20 kHz to 50 kHz	0.0083 % + 10 µV	
		50 kHz to 100 kHz	0.012 % + 30 µV	
		100 kHz to 300 kHz	0.044 % + 80 µV	
		300 kHz to 500 kHz	0.01 % + 200 µV	
		500 kHz to 1 MHz	0.18 % + 300 µV	
	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	0.005 % + 50 µV	
		20 kHz to 50 kHz	0.0084 % + 0.1 mV	
		50 kHz to 100 kHz	0.012 % + 0.2 mV	
		100 kHz to 300 kHz	0.031 % + 0.6 mV	

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Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (*k*=2) Note 3,5	Remarks
		300 kHz to 500 kHz	0.11 % + 2 mV	
		500 kHz to 1 MHz	0.17 % + 3.2 mV	
	22 V to 220 V	10 Hz to 20 Hz	0.028 % + 4 mV	
		20 Hz to 40 Hz	0.010 % + 1.5 mV	
		40 Hz to 20 kHz	0.0057 % + 0.6 mV	
		20 kHz to 50 kHz	0.0094 % + 1 mV	
		50 kHz to 100 kHz	0.017 % + 2.5 mV	
		100 kHz to 300 kHz	0.092 % + 16 mV	
		300 kHz to 500 kHz	0.45 % + 40 mV	
		500 kHz to 1 MHz	0.82 % + 80 mV	
	220 V to 1100 V	40 Hz to 1 kHz	0.011 % + 4 mV	Fluke 5720A/5725A
		1 kHz to 20 kHz	0.017 % + 6 mV	
		20 kHz to 30 kHz	0.061 % + 11 mV	
	220 V to 750 V	30 kHz to 50 kHz	0.062 % + 11 mV	
		50 kHz to 100 kHz	0.24 % + 45 mV	
LF CAPACITANCE (20/E10)				
Capacitance – Measure	0 pF to 10 pF	60 Hz to 1 kHz	0.47 % + 14 fF	GenRad 1689M
Field calibrations available Note 4	10 pF to 100 pF	60 Hz to 1 kHz	0.062 % + 14 fF	
	100 pF to 1 µF	60 Hz to 1 kHz	0.027 % + 14 fF	
	1 µF to 100 µF	60 Hz to 1 kHz	0.035 % + 18 fF	
	100 µF to 1000 µF	60 Hz to 1 kHz	0.24 % + 18 fF	
Measuring Equipment	0.1 nF to 0.5 nF	100 Hz to 1 kHz	0.65 pF	Arco SS32
Field calibrations available Note 4	0.5 nF to 1400 nF	100 Hz to 1 kHz	0.13 pF	
	0.19 nF to < 1.1 nF	10 Hz to 10 kHz	0.39 % + 7.8 pF	5520A
	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	0.21 % + 0.78 nF	
	1.1 µF to < 3.3 µF	10 Hz to 300 Hz	0.21 % + 2.3 nF	
	3.3 µF to < 11 µF	10 Hz to 150 Hz	0.21 % + 7.8 nF	

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Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (*k*=2) Note 3,5	Remarks
	11 µF to < 33 µF	10 Hz to 120 Hz	0.32 % + 23 nF	
	33 µF to < 110 µF	10 Hz to 80 Hz	0.36 % + 78 nF	
	110 µF to < 330 µF	DC to 50 Hz	0.36 % + 0.23 µF	
	0.33 mF to < 1.1 mF	DC to 20 Hz	0.36 % + 0.78 µF	
	1.1 mF to < 3.3 mF	DC to 2 Hz	0.36 % + 2.3 µF	
	3.3 mF to < 11 mF	DC to 6 Hz	0.36 % + 7.8 µF	
	11 mF to < 33 mF	DC to 0.6 Hz	0.61 % + 23 µF	
	33 mF to < 110 mF	DC to 0.2 Hz	0.90 % + 78 µF	
LF INDUCTANCE (20/E11)				
Inductance – Measure Field calibrations available Note 4	1 mH to 10 mH 10 mH to 10 H	60 Hz to 1 kHz	0.034 % + 0.1 µH 0.034 % + 1.4 µH	GenRad 1689M
Inductance – Measuring Equipment Field calibrations available Note 4	1 mH 10 mH 100 mH	1 kHz	0.12 % 0.12 % 0.12 %	Standard Inductor
LF POWER/ENERGY (20/E12)				
Power – Measuring Equipment (for current range listed below) DC Power				
0.33 mA to 330 mA	11 µW to 1.1 mW	DC	0.024 %	Fluke 5520A
	1.1 mW to 110 mW	DC	0.027 %	
	0.11W to 110 W	DC	0.024 %	
	110 W to 330 W	DC	0.018 %	
0.33 A to 3 A	11 W to 110 mW	DC	0.044 %	
	0.11 W to 990 W	DC	0.053 %	
	1 W to 3 kW	DC	0.0096 %	
3 A to 20.5 A	0.099 W to 0.99 W	DC	0.088 %	
	0.99 W to 6.8 kW	DC	0.07 %	
	6.8 W to 20.5 kW	DC	0.04 %	
AC Power Note 8 (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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	3 mW to 9 W	10 Hz to 65 Hz	0.077 %	
9 mA to 33 mA	0.3 mW to 10 mW	10 Hz to 65 Hz	0.089 %	
	10 mW to 33 W	10 Hz to 65 Hz	0.077 %	
33 mA to 90 mA	1 mW to 30 mW	10 Hz to 65 Hz	0.071 %	
	30 mW to 90 W	10 Hz to 65 Hz	0.057 %	
90 mA to 330 mA	3.0 mW to 100 mW	10 Hz to 65 Hz	0.089 %	
	100 mW to 300 W	10 Hz to 65 Hz	0.078 %	
0.33 A to 0.9 A	11 mW to 300 mW	10 Hz to 65 Hz	0.071 %	
	300 mW to 900 W	10 Hz to 65 Hz	0.081 %	
0.9 A to 2.2 A	30 mW to 720 mW	10 Hz to 65 Hz	0.089 %	
	720 mW to 2 kW	10 Hz to 65 Hz	0.079 %	
2.2 A to 4.5 A	80 mW to 1.4 W	10 Hz to 65 Hz	0.088 %	
	1.4 W to 4.5 kW	10 Hz to 65 Hz	0.18 %	
4.5 A to 20.5 A	150 mW to 6.7 W	10 Hz to 65 Hz	0.17 %	
	6.7 W to 20 kW	10 Hz to 65 Hz	0.17 %	
PHASE METERS (20/E15)				
Phase Meters – Measure Equipment Field calibrations available Note 4	0° to 180°	10 Hz to 65 Hz	0.11°	Fluke 5520A
		65 Hz to 500 Hz	0.20°	
		500 Hz to 1 kHz	0.40°	
		1 kHz to 5 kHz	1.9°	
		5 kHz to 10 kHz	3.9°	
		10 kHz to 20 kHz	7.8°	

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

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (k=2) [Note 3,5]	Remarks
TIME and FREQUENCY				
FREQUENCY DISSEMINATION (20/F01)				
Frequency – Source and Measure				
In-Lab	10 MHz		5.9×10^{-10}	Rubidium Oscillator
Field [Note 4]	10 MHz		2.9×10^{-9}	HP 5328A Counter
OSCILLATOR CHARACTERIZATION (20/F03)				
Total Harmonic Distortion 5 Hz to 600 kHz Fundamental				
Input Voltage Range < 30 V	100 % to 0.3 %	10 Hz to 1 MHz	3.5 %	Agilent 334A
		1 MHz to 3 MHz	6.9 %	
	0.1 %	10 Hz to 20 Hz	14 %	
		20 Hz to 30 Hz	6.9 %	
		30 Hz to 300 kHz	3.5 %	
		300 kHz to 500 kHz	6.9 %	
		500 kHz to 1.2 MHz	14 %	
Input Voltage Range > 30 V	100 % to 0.3 %	10 Hz to 300 kHz	3.5 %	Agilent 334A
		300 kHz to 500 kHz	6.9 %	
		500 kHz to 3 MHz	14 %	
	0.1 %	10 Hz to 20 Hz	14 %	
		20 Hz to 30 Hz	6.9 %	
		30 Hz to 300 kHz	3.5 %	
		300 kHz to 500 kHz	6.9 %	
		500 kHz to 1.2 MHz	14 %	
Total Harmonic Distortion	0 dBc to -80 dBc	10 Hz to 2 GHz	1.8 dB	Agilent 8563E and 8903B

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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
PULSE WAVEFORM (20/F04)			
Rise Time – Generate	≥ 150 ps	42 ps	Fluke 9500B
Rise Time – Measure	≥ 800 ps	930 ps	TDS 5054 Oscilloscope
MECHANICAL			
ACOUSTIC (20/M01)			
Sound Measuring Equipment Harmonic Frequency Range 125 Hz to 2 kHz 4 kHz 125 Hz to 2 kHz 4 kHz	 74 dB to 104 dB 114 dB	 0.46 dB 0.73 dB 0.37 dB 0.62 dB	GenRad 1986
FORCE (20/M06)			
Force Measuring Equipment – Tension and Compression	0 lbf to 500 lbf 50 lbf to 500 lbf 500 lbf to 2000 lbf 2000 lbf to 5000 lbf 5000 lbf to 10 000 lbf 10 000 lbf to 25 000 lbf	0.026 % + 0.001 lbf 0.31 lbf 0.45 lbf 1.9 lbf 1.5 lbf 3.9 lbf	Dead Weight – Class F Weights Interface Gold System
MASS DETERMINATION (20/M08)			
Metric	30 kg 25 kg 20 kg 10 kg 5 kg 2 kg 1 kg 500 g 200 g 100 g 50 g	33 mg 30 mg 19 mg 8.8 mg 3.7 mg 3.3 mg 1.1 mg 0.37 mg 0.16 mg 0.22 mg 90 µg	Echelon III

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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
	20 g	65 µg	
	10 g	35 µg	
	5 g	18 µg	
	2 g	27 µg	
	1 g	29 µg	
	500 mg	17 µg	
	200 mg	17 µg	
	100 mg	16 µg	
	50 mg	16 µg	
	20 mg	16 µg	
	10 mg	16 µg	
	5 mg	16 µg	
	2 mg	16 µg	
	1 mg	16 µg	
Avoirdupois	50 lb	2.3 g	Echelon III
	30 lb	1.4 g	
	20 lb	910 mg	
	10 lb	460 mg	
	5 lb	230 mg	
	3 lb	140 mg	
	2 lb	91 mg	
	1 lb	46 mg	
	8 oz	23 mg	
	4 oz	12 mg	
	2 oz	5.7 mg	
	1 oz	2.9 mg	
	0.5 oz	1.4 mg	
HARDNESS (20/M13)			
Rockwell Hardness Measuring Equipment Field calibrations available Note 4	High	0.53 HRC	Hardness Blocks
	Middle	0.73 HRC	
	Low	0.92 HRC	
	High	1.2 HRBW	

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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
	Middle Low	1.2 HRBW 1.3 HRBW	
Durometer Field calibrations available Note 4	Type A, B, O Type D, C, DO	0.31 durometer units 0.16 durometer units	Duro Calibrator, ASTM D2240
TORQUE (20/M15)			
Torque – Measure Field calibrations available Note 4	2.5 ozf-in to 1000 lbf-ft 1000 lbf-ft to 2000 lbf-ft	0.50 % 0.39 %	CDI 2000 Torque System
Torque – Measuring Equipment Field calibrations available Note 4	0 lbf-ft to 500 lbf-in 500 lbf-in to 1000 lbf-ft	0.055 % 0.074 %	Wheels/Arms/ Class F Weights
WEIGHING INSTRUMENTS (20/M16)			
Balances and Scales Field calibrations available Note 4			
Metric	30 kg 25 kg 20 kg 10 kg 5 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 200 mg	30 mg 27 mg 24 mg 8.8 mg 3.4 mg 2.0 mg 1.2 mg 0.38 mg 0.18 mg 0.12 mg 0.10 mg 81 µg 77 µg 32 µg 16 µg 16 µg 16 µg 16 µg	Characterized ASTM Class1 Mass Standards

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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
	100 mg 50 mg 20 mg 10 mg 5 mg 2 mg 1 mg	16 µg 16 µg 16 µg 16 µg 16 µg 16 µg 16 µg	
Avoirdupois	1 lb to 500 lb	0.013 %	NIST Class F Weights

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (*k*=2) Note 3,5	Remarks
ELECTROMAGNETICS – RF/MICROWAVE				
SCATTERING PARAMETERS (20/R18)				
Relative RF Power	- 30 dB to 20 dB	100 kHz to 4.2 GHz	1.7 %	Agilent 437 with 8482A

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty (*k*=2) Note 3,5	Remarks
THERMODYNAMIC			
HUMIDITY (20/T02)			
Relative Humidity – Measuring Equipment	10 % RH to 90 % RH (0 °C to 70 °C)	0.50 % RH	Thunder Scientific 2500
Relative Humidity – Measure Field calibrations available Note 4	20 % RH to 80 % RH (10 °C to 30 °C)	1.3 % RH	Vaisala HMI41/HMP46

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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
LABORATORY THERMOMETERS, DIGITAL and ANALOG (20/T03)			
Temperature Measuring Equipment	-80 °C to 100 °C 100 °C to 200 °C 200 °C to 300 °C 300 °C to 600 °C	0.022 °C 0.023 °C 0.070 °C 0.085 °C	Liquid Bath/Hart 5628 Dry Block/Hart 5628
Temperature Measure	-195 °C to 0 °C 0 °C to 420 °C 420°C to 600 °C	0.012 °C + 0.001 % 0.026 °C + 0.001 % 0.036 °C + 0.001 %	Hart 5628
PRESSURE (20/T05)			
Absolute Pressure Source – Pneumatic	0 psia to 30 psia 30 psia to 1000 psia	0.0024 psia 0.0067 % + 0.00048 psia	DHI PPC4 w/ RPM4 Indicator
Gage Pressure Pneumatic	-15 psig to 30 psig 30 psi to 1000 psi	0.002 psi 0.0067 % + 0.0001 psi	
	-2 inH_2O to 2 inH_2O -36 inH_2O to -22 inH_2O -22 inH_2O to 22 inH_2O 22 inH_2O to 60 inH_2O 60 inH_2O to 72 inH_2O 72 inH_2O to 804 inH_2O	0.00061 inH_2O 0.0090 % + 150 µinH_2O 0.0022 inH_2O 0.0095 % + 150 µinH_2O 0.0066 inH_2O 0.0095 % + 150 µinH_2O	Dwyer 1430 Microtetor DHI PPC 4 Controller
	0.14 psig to 25 psig	0.018 % + 44 µpsi	Ametek RK-1100 WC
Gage Pressure, Hydraulic	10 psig to 16 000 psig	0.012 %	Pressurements P3125-3
RADIATION THERMOMETRY (20/T06)			
Infrared Temperature Measuring Equipment	-15 °C to 0 °C 0 °C to 50 °C 50 °C to 100 °C 100 °C to 120 °C	0.79 °C 0.53 °C 0.68 °C 0.75 °C	Fluke Black Body

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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
	120 °C to 200 °C 200 °C to 350 °C 350 °C to 500 °C	0.98 °C 1.7 °C 2.3 °C	
TEMPERATURE INDICATORS (20/T08)			
Electrical Simulation of Thermocouple Devices			
Type E	-250 °C to -100 °C -100 °C to -25 °C -25 °C to 350 °C 350 °C to 650 °C 650 °C to 1000 °C	0.39 °C 0.12 °C 0.11 °C 0.12 °C 0.16 °C	Fluke 5520A
Type J	-210 °C to -100 °C -100 °C to -30 °C -30 °C to 150 °C 150 °C to 760 °C 760 °C to 1200 °C	0.21 °C 0.13 °C 0.11 °C 0.13 °C 0.18 °C	
Type K	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 1000 °C 1000 °C to 1372 °C	0.26 °C 0.14 °C 0.13 °C 0.20 °C 0.31 °C	
Type T	-250 °C to -150 °C -150 °C to 0°C 0°C to 120 °C 120 °C to 400 °C	0.49 °C 0.19 °C 0.13 °C 0.11 °C	
Type R	0 °C to 250 °C 250°C to 400 °C 400 °C to 1000 °C 1000 °C to 1767 °C	0.44 °C 0.27 °C 0.26 °C 0.31 °C	
Type S	0 °C to 250 °C	0.37 °C	

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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
Type N	250°C to 1000 °C 1000 °C to 1400 °C 1400 °C to 1767 °C -200 °C to -100 °C -100 °C to -25 °C -25°C to 120 °C 120 °C to 410 °C 410 °C to 1300 °C	0.28 °C 0.29 °C 0.36 °C 0.31 °C 0.17 °C 0.15 °C 0.14 °C 0.21 °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 measure 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.

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