

## Scope of Capabilities

Calibration Specialty, Inc. maintains a wide variety of calibration services. New capabilities are added each year. The following is a comprehensive list of our general services:

### 1. Electrical

<u>Parameter/Equipment</u>	<u>Range</u>	<u>Accuracy</u>	<u>Comments</u>
<u>DC Voltage – Generate</u>	0 to 329.9999 mV	± 3 ppm + 1 μV	Fluke 5520A
	0 to 3.299999 V	±11 ppm + 2 μV	
	0 to 32.99999 V	±12 ppm + 15 μV	
	30 to 329.9999 V	±18 ppm + 150 μV	
	100 to 1000.000 V	±18 ppm + 1500 μV	
<u>DC Current – Generate</u>	0 to 329.999 μA	± 150 ppm + 0.02 μA	Fluke 5520A
	0 to 3.29999 mA	± 100 ppm + 0.05 μA	
	0 to 32.9999 mA	± 100 ppm + 0.25 μA	
	0 to 329.999 mA	± 100 ppm + 2.5 μA	
	0 to 1.09999 A	± 200 ppm + 40 μA	
	1.1 to 2.99999 A	± 380 ppm + 40 μA	
	0 to 10.9999 A	± 500 ppm + 500 μA	
11 to 20.5 A	±1000 ppm + 750 μA		
<u>Resistance – Generate</u>	0 to 10.9999 Ω	± 40 ppm + 0.01 Ω	Fluke 5520A
	11 to 32.9999 Ω	± 30 ppm + 0.015 Ω	
	33 to 109.9999 Ω	± 28 ppm + 0.015 Ω	
	110 to 329.9999 Ω	± 28 ppm + 0.02 Ω	
	330 Ω to 1.099999 kΩ	± 28 ppm + 0.02 Ω	
	1.1 to 3.299999 kΩ	± 28 ppm + 0.2 Ω	
	3.3 to 10.99999 kΩ	± 28 ppm + 0.1 Ω	
	11 to 32.99999 kΩ	± 28 ppm + 1 Ω	
	33 to 109.9999 kΩ	± 28 ppm + 1 Ω	
	110 to 329.9999 kΩ	± 32 ppm + 10 Ω	
	330kΩ to 1.099999MΩ	± 32 ppm + 10 Ω	
	1.1 to 3.299999 MΩ	± 60 ppm + 150 Ω	
	3.3 to 10.99999 MΩ	± 130 ppm + 250 Ω	
	11 to 32.99999 MΩ	± 250 ppm + 2500 Ω	
	33 to 109.9999 MΩ	± 500 ppm + 3000 Ω	
110 to 329.9999 MΩ	± 3000 ppm + 100000 Ω		
330 to 1100 MΩ	±15000 ppm + 500000 Ω		

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### 1. Electrical

<u>Parameter/Equipment</u>	<u>Range</u>	<u>Accuracy</u>	<u>Comments</u>
<u>Capacitance – Generate</u>	0.19 to 0.3999 nF	±0.5% + 0.01 nF	Fluke 5520A
	0.4 to 1.0999 nF	±0.5% + 0.01 nF	
	1.1 to 3.2999 nF	±0.5 % + 0.01 nF	
	3.3 to 10.9999 nF	±0.25% + 0.01 nF	
	11 to 32.9999 nF	±0.25% + 0.10 nF	
	33 to 109.999 nF	±0.25% + 0.10 nF	
	110 to 329.999 nF	±0.25% + 0.30 nF	
	0.33 to 1.09999 μF	±0.25% + 1.00 nF	
	1.1 to 3.29999 μF	±0.25% + 3.00 nF	
	3.3 to 10.9999 μF	±0.25% + 10.0 nF	
	11 to 32.9999 μF	±0.40% + 30.0 nF	
	33 to 109.999 μF	±0.45% + 100.0 nF	
	110 to 329.999 μF	±0.45% + 300.0 nF	
	0.33 μF to 1.09999 mF	±0.45% + 1.000 μF	
	1.1 to 3.2999 mF	±0.45% + 3.000 μf	
	3.3 to 10.9999 mF	±0.45% + 10.00 μf	
11 to 32.9999 mF	±0.75% + 30.00 μF		
33 to 110 mF	±1.1 % + 100.0 μF		
<u>Thermocouple – Generate and Measure</u>			Fluke 5520A
Type B	600 to 800 °C	± 0.44 °C	
	800 to 1000 °C	± 0.34 °C	
	1000 to 1550 °C	± 0.30 °C	
	1550 to 1820 °C	± 0.33 °C	
Type C	0 to 150 °C	± 0.30 °C	Fluke 5520A
	150 to 650 °C	± 0.26 °C	
	650 to 1000 °C	± 0.31 °C	
	1000 to 1800 °C	± 0.50 °C	
	1800 to 2316 °C	± 0.84 °C	

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<u>Parameter/Equipment</u>	<u>Range</u>	<u>Accuracy</u>	<u>Comments</u>
<u>Thermocouple – Generate and Measure</u>			Fluke 5520A
Type E	-250 to -100 °C	± 0.50 °C	
	-100 to -25 °C	± 0.16 °C	
	-25 to 350 °C	± 0.14 °C	
	350 to 650 °C	± 0.16 °C	
	650 to 1000 °C	± 0.21 °C	
Type J	-210 to -100 °C	± 0.27 °C	Fluke 5520A
	-100 to -30 °C	± 0.16 °C	
	-30 to 150 °C	± 0.14 °C	
	150 to 760 °C	± 0.17 °C	
	760 to 1200 °C	± 0.23 °C	
Type K	-200 to -100 °C	± 0.33 °C	Fluke 5520A
	-100 to -25 °C	± 0.18 °C	
	-25 to 120 °C	± 0.16 °C	
	120 to 1000 °C	± 0.26 °C	
	1000 to 1372 °C	± 0.40 °C	
Type L	-200 to -100 °C	± 0.37 °C	Fluke 5520A
	-100 to 800 °C	± 0.26 °C	
	800 to 900 °C	± 0.17 °C	
Type N	-200 to -100 °C	± 0.40 °C	Fluke 5520A
	-100 to -25 °C	± 0.22 °C	
	-25 to 120 °C	± 0.19 °C	
	120 to 410 °C	± 0.18 °C	
	410 to 1300 °C	± 0.27 °C	
Type R	0 to 250 °C	± 0.57 °C	Fluke 5520A
	250 to 400 °C	± 0.35 °C	
	400 to 1000 °C	± 0.33 °C	
	1000 to 1767 °C	± 0.40 °C	

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<u>Parameter/Equipment</u>	<u>Range</u>	<u>Accuracy</u>	<u>Comments</u>
<u>Thermocouple – Generate and Measure</u>			Fluke 5520A
Type S	0 to 250 °C	± 0.47 °C	
	250 to 1000 °C	± 0.36 °C	
	1000 to 1400 °C	± 0.37 °C	
	1400 to 1767 °C	± 0.46 °C	
Type T	-250 to -150 °C	± 0.63 °C	Fluke 5520A
	-150 to 0 °C	± 0.24 °C	
	0 to 120 °C	± 0.16 °C	
	120 to 400 °C	± 0.14 °C	
Type U	-200 to 0 °C	± 0.56 °C	Fluke 5520A
	0 to 600 °C	± 0.27 °C	
<u>RTD Indicators-Generate</u>			Fluke 5520A
Pt 395, 100 Ω	-200 to -80 °C	tcal ±5 °C ±0.05 °C	
	-80 to 0 °C	tcal ±5 °C ±0.05 °C	
	0 to 100 °C	tcal ±5 °C ±0.07 °C	
	100 to 300 °C	tcal ±5 °C ±0.09 °C	
	300 to 400 °C	tcal ±5 °C ±0.10 °C	
	400 to 630 °C	tcal ±5 °C ±0.12 °C	
	630 to 800 °C	tcal ±5 °C ±0.23 °C	
Pt 3926, 100 Ω	-200 to -80 °C	tcal ±5 °C ±0.05 °C	Fluke 5520A
	-80 to 0 °C	tcal ±5 °C ±0.05 °C	
	0 to 100 °C	tcal ±5 °C ±0.07 °C	
	100 to 300 °C	tcal ±5 °C ±0.09 °C	
	300 to 400 °C	tcal ±5 °C ±0.10 °C	
	400 to 630 °C	tcal ±5 °C ±0.12 °C	

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<u>Parameter/Equipment</u>	<u>Range</u>	<u>Accuracy</u>	<u>Comments</u>
<u>RTD Indicators-Generate</u>			
Pt 3916, 100 $\Omega$	-200 to -190 °C	tcal $\pm 5$ °C $\pm 0.25$ °C	Fluke 5520A
	-190 to -80 °C	tcal $\pm 5$ °C $\pm 0.04$ °C	
	-80 to 0 °C	tcal $\pm 5$ °C $\pm 0.05$ °C	
	0 to 100 °C	tcal $\pm 5$ °C $\pm 0.06$ °C	
	100 to 260 °C	tcal $\pm 5$ °C $\pm 0.07$ °C	
	260 to 300 °C	tcal $\pm 5$ °C $\pm 0.08$ °C	
	300 to 400 °C	tcal $\pm 5$ °C $\pm 0.09$ °C	
	400 to 600 °C	tcal $\pm 5$ °C $\pm 0.10$ °C	
Pt 385, 200 $\Omega$	-200 to -80 °C	tcal $\pm 5$ °C $\pm 0.04$ °C	Fluke 5520A
	-80 to 0 °C	tcal $\pm 5$ °C $\pm 0.04$ °C	
	0 to 100 °C	tcal $\pm 5$ °C $\pm 0.04$ °C	
	100 to 260 °C	tcal $\pm 5$ °C $\pm 0.05$ °C	
	260 to 300 °C	tcal $\pm 5$ °C $\pm 0.12$ °C	
	300 to 400 °C	tcal $\pm 5$ °C $\pm 0.13$ °C	
	400 to 600 °C	tcal $\pm 5$ °C $\pm 0.14$ °C	
	600 to 630 °C	tcal $\pm 5$ °C $\pm 0.16$ °C	
Pt 385, 500 $\Omega$	-200 to -80 °C	tcal $\pm 5$ °C $\pm 0.04$ °C	Fluke 5520A
	-80 to 0 °C	tcal $\pm 5$ °C $\pm 0.05$ °C	
	0 to 100 °C	tcal $\pm 5$ °C $\pm 0.05$ °C	
	100 to 260 °C	tcal $\pm 5$ °C $\pm 0.06$ °C	
	260 to 300 °C	tcal $\pm 5$ °C $\pm 0.08$ °C	
	300 to 400 °C	tcal $\pm 5$ °C $\pm 0.08$ °C	
	400 to 600 °C	tcal $\pm 5$ °C $\pm 0.09$ °C	
	600 to 630 °C	tcal $\pm 5$ °C $\pm 0.11$ °C	

## Scope of Capabilities

### 1. Electrical

<u>Parameter/ Range</u>	<u>Frequency</u>	<u>Accuracy</u>	<u>Comments</u>
<u>RTD Indicators-Generate</u>			
Pt 385, 1000 Ω	-200 to -80 °C	tcal ±5 °C ±0.03 °C	Fluke 5520A
	-80 to 0 °C	tcal ±5 °C ±0.03 °C	
	0 to 100 °C	tcal ±5 °C ±0.04 °C	
	100 to 260 °C	tcal ±5 °C ±0.05 °C	
	260 to 300 °C	tcal ±5 °C ±0.06 °C	
	300 to 400 °C	tcal ±5 °C ±0.07 °C	
	400 to 600 °C	tcal ±5 °C ±0.07 °C	
	600 to 630 °C	tcal ±5 °C ±0.23 °C	
<u>AC Voltage- Generate</u>			Fluke 5520A
1.0 to 32.999 mV	10 to 45 Hz	800 ppm + 6 μV	
	45 Hz to 10 kHz	150 ppm + 6 μV	
	10 to 20 kHz	200 ppm + 6 μV	
	20 to 50 kHz	1000 ppm + 6 μV	
	50 to 100 kHz	3500 ppm + 12 μV	
	100 to 500 kHz	8000 ppm + 50 μV	
33 to 329.999 mV	10 to 45 Hz	300 ppm + 8 μV	Fluke 5520A
	45 Hz to 10 kHz	145 ppm + 8 μV	
	10 to 20 kHz	160 ppm + 8 μV	
	20 to 50 kHz	350 ppm + 8 μV	
	50 to 100 kHz	800 ppm + 32 μV	
	100 to 500 kHz	2000 ppm + 70 μV	
0.33 to 3.29999 V	10 to 45 Hz	300 ppm + 50 μV	Fluke 5520A
	45 Hz to 10 kHz	150 ppm + 60 μV	
	10 to 20 kHz	190 ppm + 60 μV	
	20 to 50 kHz	300 ppm + 50 μV	
	50 to 100 kHz	700 ppm + 125 μV	
	100 to 500 kHz	2400 ppm + 600 μV	

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<u>Parameter/ Range</u>	<u>Frequency</u>	<u>Accuracy</u>	<u>Comments</u>
<u>AC Voltage- Generate</u>			Fluke 5520A
3.3 to 32.9999 V	10 to 45 Hz	300 ppm + 650 $\mu$ V	
	45 Hz to 10 kHz	150 ppm + 600 $\mu$ V	
	10 to 20 kHz	240 ppm + 600 $\mu$ V	
	20 to 50 kHz	350 ppm + 600 $\mu$ V	
	50 to 100 kHz	900 ppm + 1600 $\mu$ V	
33 to 329.999 V	45 Hz to 1 kHz	190 ppm + 2000 $\mu$ V	Fluke 5520A
	1 to 10 kHz	200 ppm + 6000 $\mu$ V	
	10 to 20 kHz	250 ppm + 6000 $\mu$ V	
	20 to 50 kHz	300 ppm + 6000 $\mu$ V	
	50 to 100 kHz	2000ppm + 50000 $\mu$ V	
330 to 1020 V	45 Hz to 1 kHz	300 ppm + 10000 $\mu$ V	Fluke 5520A
	1 to 5 kHz	250 ppm + 10000 $\mu$ V	
	5 to 10 kHz	300 ppm + 10000 $\mu$ V	
10 to 329.999 mV	10 to 20 Hz	0.2 % + 370 $\mu$ V	Fluke 5520A
	20 to 45 Hz	0.1 % + 370 $\mu$ V	
	45 Hz to 1 kHz	0.1 % + 370 $\mu$ V	
	1 to 5 kHz	0.2 % + 450 $\mu$ V	
	5 to 10 kHz	0.4 % + 450 $\mu$ V	
	10 to 30 kHz	0.5 % + 900 $\mu$ V	
0.33 to 3.29999 V	10 to 20 Hz	0.2 % + 450 $\mu$ V	Fluke 5520A
	20 to 45 Hz	0.1 % + 450 $\mu$ V	
	45 Hz to 1 kHz	0.09 % + 450 $\mu$ V	
	1 to 5 kHz	0.2 % + 1400 $\mu$ V	
	5 to 10 kHz	0.4 % + 1400 $\mu$ V	
	10 to 30 kHz	5.0 % + 2800 $\mu$ V	

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<u>Parameter/ Range</u>	<u>Frequency</u>	<u>Accuracy</u>	<u>Comments</u>
<u>AC Voltage- Generate</u>			Fluke 5520A
3.3 to 5 V	10 to 20 Hz	0.2 % + 450 $\mu$ V	
	20 to 45 Hz	0.1 % + 450 $\mu$ V	
	45 Hz to 1 kHz	0.09 % + 450 $\mu$ V	
	1 to 5 kHz	0.2 % + 1400 $\mu$ V	
	5 to 10 kHz	0.4 % + 1400 $\mu$ V	
<u>AC Current – Generate</u>			Fluke 5520A
29.00 to 329.99 $\mu$ A	10 to 20 Hz	0.2 % + 0.1 $\mu$ A	
	20 to 45 Hz	0.15 % + 0.1 $\mu$ A	
	45 Hz to 1 kHz	0.125 % + 0.1 $\mu$ A	
	1 to 5 kHz	0.3 % + 0.15 $\mu$ A	
	5 to 10 kHz	0.8 % + 0.2 $\mu$ A	
	10 to 30 kHz	1.6 % + 0.4 $\mu$ A	
0.33 to 3.2999 mA	10 to 20 Hz	0.2 % + 0.15 $\mu$ A	
	20 to 45 Hz	0.125 % + 0.15 $\mu$ A	
	45 Hz to 1 kHz	0.1 % + 0.15 $\mu$ A	
	1 to 5 kHz	0.2 % + 0.2 $\mu$ A	
	5 to 10 kHz	0.5 % + 0.3 $\mu$ A	
	10 to 30 kHz	1.0 % + 0.6 $\mu$ A	
3.3 to 32.999 mA	10 to 20 Hz	0.18 % + 2 $\mu$ A	Fluke 5520A
	20 to 45 Hz	0.09 % + 2 $\mu$ A	
	45 Hz to 1 kHz	0.04 % + 2 $\mu$ A	
	1 to 5 kHz	0.08 % + 2 $\mu$ A	
	5 to 10 kHz	0.2 % + 3 $\mu$ A	
	10 to 30 kHz	0.4 % + 4 $\mu$ A	



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### 1. Electrical

<u>Parameter/ Range</u>	<u>Frequency</u>	<u>Accuracy</u>	<u>Comments</u>
<u>AC Current – Generate</u>			Fluke 5520A
33 to 329.99 mA	10 to 20 Hz	0.18 % + 20 $\mu$ A	
	20 to 45 Hz	0.09 % + 20 $\mu$ A	
	45 Hz to 1 kHz	0.04 % + 20 $\mu$ A	
	1 to 5 kHz	0.10 % + 50 $\mu$ A	
	5 to 10 kHz	0.2 % + 100 $\mu$ A	
	10 to 30 kHz	0.4 % + 200 $\mu$ A	
33 to 329.99 mA	10 to 20 Hz	0.18 % + 20 $\mu$ A	Fluke 5520A
	20 to 45 Hz	0.09 % + 20 $\mu$ A	
	45 Hz to 1 kHz	0.04 % + 20 $\mu$ A	
	1 to 5 kHz	0.10 % + 50 $\mu$ A	
	5 to 10 kHz	0.2 % + 100 $\mu$ A	
	10 to 30 kHz	0.4 % + 200 $\mu$ A	
0.33 to 1.09999 A	10 to 45 Hz	0.18 % + 100 $\mu$ A	Fluke 5520A
	45 Hz to 1 kHz	0.05 % + 100 $\mu$ A	
	1 to 5 kHz	0.6 % + 1000 $\mu$ A	
	5 to 10 kHz	2.5 % + 5000 $\mu$ A	
1.1 to 2.99999 A	10 to 45 Hz	0.18 % + 100 $\mu$ A	
	45 Hz to 1 kHz	0.06 % + 100 $\mu$ A	
	1 to 5 kHz	0.6 % + 1000 $\mu$ A	
	5 to 10 kHz	2.5 % + 5000 $\mu$ A	
3 to 10.9999 A	45 to 100 Hz	0.06 % + 2000 $\mu$ A	Fluke 5520A
	100 Hz to 1 kHz	0.10 % + 2000 $\mu$ A	
	1 to 5 kHz	3.0 % + 2000 $\mu$ A	
11 to 20.5 A	45 to 100 Hz	0.12 % + 5000 $\mu$ A	Fluke 5520A
	100 Hz to 1 kHz	0.13 % + 5000 $\mu$ A	
	1 to 5 kHz	3.0 % + 5000 $\mu$ A	

## Scope of Capabilities

### 1. Electrical

<u>Parameter/ Range</u>	<u>Frequency</u>	<u>Accuracy</u>	<u>Comments</u>
<u>Scope Volt Generate</u>			Fluke 5520A SC-300
DC into 50 Ohm	0V to $\pm 2.2V$	$\pm 0.25\%$ of output $\pm 100 \mu V$	
DC into 1 Mohm	0V to $\pm 33V$	$\pm 0.25\%$ of output $\pm 100 \mu V$	
Square into 50 Ohm	1.8mV to 4.5mVp-p	$\pm 0.25\%$ of output $\pm 200 \mu V$	
<u>Scope Volt Generate</u>			Fluke 5520A SC-300
Square into 1 Mohm	1.8mV to 4.5mVp-p	$\pm 0.25\%$ of output $\pm 200 \mu V$	
	4.5mmV to 95Vp-p	$\pm 0.25\%$ of output $\pm 100 \mu V$	
	95Vp-p to 105Vp-p 10Hz to 100Hz	$\pm 1.5\%$ of output $\pm 100 \mu V$	
	95Vp-p to 105Vp-p 100Hz to 10kHz	$\pm 0.5\%$ of output $\pm 100 \mu V$	
<u>Scope Edge Generate</u>			Fluke 5520A SC-300
Range p-p	4.5mV to 2.75mV	$\pm 2\%$ of output $\pm 200 \mu V$	
Rise Time		<400ps	

## Scope of Capabilities

### 1. Electrical

<u>Parameter/ Range</u>	<u>Frequency</u>	<u>Accuracy</u>	<u>Comments</u>
<u>Scope Levelled Sine Wave Generate</u>			Fluke 5520A SC-300
Range p-p	5mV to 5.5V 50kHz Reference	±2% of output ±200µV	
	5mV to 5.5V 50kHz to 100MHz	±3.5% of output ±300µV ±1.5% of output ±100µV flatness w.r.t. 50kHz Reference	
<u>Scope Levelled Sine Wave Generate</u>			Fluke 5520A SC-300
Range p-p	5mV to 5.5V 50kHz to 250MHz	±4.0% of output ±300µV ±2.0% of output ±100µV flatness w.r.t. 50kHz Reference	
	5mV to 3.0V 50kHz to 350MHz	±4.0% of output ±300µV ±2.0% of output ±100µV flatness w.r.t. 50kHz Reference	
<u>Scope Time Marker Generate</u>			Fluke 5520A SC-300
	5s to 100us	±(25+t*1000)ppm	
	50us to 2us	±(25+t*15000)ppm	
	1us to 20ns	±25ppm	
	10us to 2ns	±25ppm	

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### 1. Electrical

<u>Parameter/ Range</u>	<u>Frequency</u>	<u>Accuracy</u>	<u>Comments</u>
<u>Scope Wave Generate</u>			Fluke 5520A SC-300
Into 1M $\Omega$	1.8mV to 55Vp-p	$\pm 3\%$ of output $\pm 100\mu\text{V}$	
Into 50 $\Omega$	1.8mV to 2.2Vp-p	$\pm 3\%$ of output $\pm 100\mu\text{V}$	

### DC Voltage Measure

Accuracy (ppm of Reading + ppm of Range)			Hewlett Packard 3458A
	100 mV	9 + 3	
	1 V	8 + 0.3	
	10 V	8 + 0.05	
	100 V	10 + 0.3	
	1000 V	10 + 0.1	

### Resistance Measure

Accuracy (ppm of Reading + ppm of Range)			Hewlett Packard 3458A
	10 $\Omega$	15 + 5	
	100 $\Omega$	12 + 5	
	1 k $\Omega$	10 + 5	
	10 k $\Omega$	10 + 0.5	
	100 k $\Omega$	10 + 0.5	

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### 1. Electrical

<u>Parameter/ Range</u>	<u>Frequency</u>	<u>Accuracy</u>	<u>Comments</u>
<u>Resistance Measure</u>			
Accuracy (ppm of Reading + ppm of Range)			Hewlett Packard 3458A
	1 MΩ	15 + 2	
	10 MΩ	50 + 10	
	100 MΩ	500 + 10	
	1 GΩ	0.5% + 10	
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<u>DC Current Measure</u>			
Accuracy (ppm of Reading + ppm of Range)			Hewlett Packard 3458A
	100 nA	30 + 400	
	1 μA	20 + 40	
	10 μA	20 + 10	
	100 μA	20 + 8	
	1 mA	20 + 5	
	10 mA	20 + 5	
	100 mA	35 + 5	
	1 A	110 + 10	

## Scope of Capabilities

### 1. Electrical

<u>Parameter/ Range</u>	<u>Frequency</u>	<u>Accuracy</u>	<u>Comments</u>
<u>AC Voltage Measure</u>			
Accuracy (% of Reading + % of Range)			Hewlett Packard 3458A
1 Hz to 40 Hz	10 mV	0.03 + 0.03	
	100 mV-10 V	0.007 + 0.004	
	100 V	0.02 + 0.004	
	1000 V	0.04 + 0.004	
40 Hz to 1 kHz	10 mV	0.02 + 0.011	
	100 mV-10 V	0.007 + 0.002	
	100 V	0.02 + 0.002	
	1000 V	0.04 + 0.002	

<u>AC Voltage Measure</u>	ACBAND $\leq$ 2 MHz		
Accuracy (% of Reading + % of Range)			Hewlett Packard 3458A
1 kHz to 20 kHz	10 mV	0.03 + 0.011	
	100 mV-10 V	0.014 + 0.002	
	100 V	0.02 + 0.002	
	1000 V	0.06 + 0.002	
20 kHz to 50 kHz	10 mV	0.1 + 0.011	
	100 mV-10 V	0.03 + 0.002	
	100 V	0.035 + 0.002	
	1000 V	0.12 + 0.002	

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### 1. Electrical

<u>Parameter/ Range</u>	<u>Frequency</u>	<u>Accuracy</u>	<u>Comments</u>
<u>AC Voltage Measure</u>		ACBAND $\leq$ 2 MHz	
Accuracy (% of Reading + % of Range)			Hewlett Packard 3458A
50 kHz to 100 kHz	10 mV	0.5 + 0.011	
	100 mV-10 V	0.08 + 0.002	
	100 V	0.012 + 0.002	
	1000 V	0.3 + 0.002	
100 kHz to 300 kHz	10 mV	4.0 + 0.02	
	100 mV-10 V	0.3 + 0.01	
	100 V	0.4 + 0.01	
300 kHz to 1 MHz	100 mV-10 V	1 + 0.01	
	100 V	1.5 + 0.01	
1 MHz to 2 MHz	100 mV-10 V	1.5 + 0.01	

<u>AC Voltage Measure</u>		ACBAND $>$ 2 MHz	
Accuracy (% of Reading + % of Range)			Hewlett Packard 3458A
45 Hz to 100 kHz	10 mV	0.09 + 0.06	
	100 mV – 10 V	0.09 + 0.06	
	100 V	0.12 + 0.002	
	1000 V	0.3 + 0.01	
100 kHz to 1 MHz	10 mV	1.2 + 0.05	
	100 mV – 10 V	2.0 + 0.05	

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### 1. Electrical

<u>Parameter/ Range</u>	<u>Frequency</u>	<u>Accuracy</u>	<u>Comments</u>
<u>AC Voltage Measure</u>		ACBAND > 2 MHz	
Accuracy (% of Reading + % of Range)			Hewlett Packard 3458A
1 MHz to 4 MHz	10 mV	7 + 0.07	
	100 mV – 10 V	4 + 0.07	
4 MHz to 8 MHz	10 mV	20 + 0.08	
	100 mV – 10 V	4 + 0.08	
8 MHz to 10 MHz	100 mV – 10 V	15 + 0.01	
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<u>AC Current Measure</u>			
Accuracy (% of Reading + % of Range)			Hewlett Packard 3458A
10 Hz to 20 Hz	100 $\mu$ A	0.4 + 0.03	
	1 mA – 100 mA	0.4 + 0.02	
	1A	0.4 + 0.02	
20 Hz to 45 Hz	100 $\mu$ A	0.15 + 0.03	
	1 mA – 100 mA	0.15 + 0.02	
	1A	0.16 + 0.02	



## Scope of Capabilities

### 1. Electrical

<u>Parameter/ Range</u>	<u>Frequency</u>	<u>Accuracy</u>	<u>Comments</u>
<u>AC Current Measure</u>			
Accuracy (% of Reading + % of Range)			Hewlett Packard 3458A
45 Hz to 100 Hz	100 $\mu$ A	0.06 + 0.03	
	1 mA – 100 mA	0.06 + 0.02	
	1A	0.08 + 0.02	
100 Hz to 5 kHz	100 $\mu$ A	0.06 + 0.03	
	1 mA – 100 mA	0.03 + 0.02	
	1A	0.1 + 0.02	
5 kHz to 20 kHz	1 mA – 100 mA	0.06 + 0.02	
	1A	0.3 + 0.02	
20 kHz to 50 kHz	1 mA – 100 mA	0.4 + 0.04	
	1A	1 + 0.04	
50 kHz to 100 kHz	1 mA – 100 mA	0.55 + 0.15	

### Frequency / Period

Frequency Accuracy	$1 \times 10^{-12}$ Hz	Hewlett Packard 58503A GPS Receiver
Period 10 ns to Frequency 1300MHz		Hewlett Packard 5335A

## Scope of Capabilities

### 2. Temperature

<u>Parameter/Equipment</u>	<u>Range</u>	<u>Accuracy</u>	<u>Comments</u>
<u>Generate</u>			
Dry Block Calibrator	100 to 600 °C	±0.5 °C	Hart Scientific 9144
Infrared Blackbody	100 to 500 °C	±2% of setting	Hart Scientific 4181
Environmental Chamber	0 to 94 °C	±0.5 °C	Associated Environmental Systems LH-6
<hr/>			
<u>Measure</u>			
Platinum Resistance Thermometer	-200 to -1.0 °C	±0.006 °C	Hart Scientific 5626
	0 to 419 °C	± 0.004 °C	
	420 to 660 °C	±0.009 °C	
	661 °C	±0.014 °C	
Temperature Probe	-50 to 120 °C	±0.2 °C	Vaisala HMP76
<hr/>			
<u>Humidity Generate</u>			
Environmental Chamber	20 to 98% RH	±2.0% RH	Associated Environmental Systems LH-6
<hr/>			
<u>Humidity Measure</u>			
Humidity Probe	0 to 90% RH	±1% RH	Vaisala HMP76
	90 to 100% RH	±1.7% RH	

## Scope of Capabilities

### 3. Dimensional

<u>Parameter/Equipment</u>	<u>Range</u>	<u>Accuracy</u>	<u>Comments</u>
Gage Blocks	0.1001 to 4 in	$\pm 6.3 \mu\text{in}$	Edmunds Tol 2200
	5 to 20 in	$\pm 28 \mu\text{in}$	Twin Head Ultra Precision Comparator
Pitch Diameter	4 to 80	ANSI/ASME B1.2 1983	Deltronic Thread Wires w/ P&W Supermic Model C
	0.35 to 10.0 mm	ANSI/ASME B1.16M 1984	
Length	0.010 to 0.05 in	$\pm 10 \mu\text{in}$	Mitutoyo 521-102
	0-10 in (Comparator)	$\pm 20 \mu\text{in}$	Supermic Model C
	0-10 in (Micrometer)	$\pm .001 \text{ in}$	Supermic Model C
	10 to 100 in	$\pm 100 \mu\text{in}$	Gage Blocks
Internal	Up to 12 in	$\pm .0008 \text{ in}$	Sheffield N-9 Internal Comparator
Mass	1 to 500 mg	$\pm 0.010 \text{ mg}$	Rice Lake SS Weights
	1 to 500 g	$\pm 1.2 \text{ mg}$	Type II, Class 1
	1 to 5 kg	$\pm 12 \text{ mg}$	
Hardness	HRC		Direct/Indirect Verification ASTM E18
	HRB		
	HRE		
	T Superficial		

## Scope of Capabilities

### 4. Pressure

<u>Parameter/Equipment</u>	<u>Range</u>	<u>Accuracy</u>	<u>Comments</u>
Absolute	0 to 30 psia	± 0.01% I.V.	Ruska 7210A0030
	Pitot 103 inHga	± 0.008 inHg	Ruska 6660-804
	Static 33 inHga	±0.004 inHg	
<hr/>			
Vacuum	0 to 30 psia	± 0.01% I.V.	Ruska 7210A0030
	Pitot 103 inHga	± 0.008 inHg	Ruska 6660-804
	Static 33 inHga	±0.004 inHg	
<hr/>			
Pressure	0 to 12 in H <sub>2</sub> O	± 0.001 in H <sub>2</sub> O	Dwyer 1425-12
	4 to 400 in H <sub>2</sub> O	± 0.05% I.V.	Ametek PK254-15
	0 to 15 psi		
	0.2 to 25 psi	± 0.0015% I.V.	Ruska 2465-725
	0 to 320 psi	±0.011% I.V.	Ruska 7215Xi-10G-05
	0-100 psi	± 0.06% F.S.	Eaton UPS 3000CC
	0-250 psi	± 0.06% F.S.	
	0-500 psi	± 0.06% F.S.	
	2.0 to 1000 psi	± 0.0015% I.V.	Ruska 2465-729
	6.0 to 2400 psi	± 0.01% I.V.	Ruska 2400-736
	0 to 1000 psi	± 0.06% F.S.	Eaton UPS 3000ACC
	0 to 2500 psi	± 0.06% F.S.	
	0 to 5000 psi	± 0.06% F.S.	
30 to 12000 psi	± 0.01% I.V.	Ruska 2400-735	

## Scope of Capabilities

### 4. Pressure

<u>Parameter/Equipment</u>	<u>Range</u>	<u>Accuracy</u>	<u>Comments</u>
	0-20000 psi	±0.1% F.S.	Heise H

### 5. Torque

<u>Parameter/Equipment</u>	<u>Range</u>	<u>Accuracy</u>	<u>Comments</u>
Torque Analyzer	0-110 in-oz	± 1.0% I.V. + 1/2 in-oz	Cleco H-010
Torque Analyzer	0-50 lb-in	± 1.0% 10% to 20% I.V.	Mountz TL50i
		±0.5% 20% to 100% I.V.	
Torque Transducer	0-250 lb-in	± 0.5% I.V.	Norbar 50063.ETS
Torque Transducer	0-100 lb-ft	± 0.5% I.V.	Norbar 50008.ETS
Torque Transducer	0-500 lb-ft	± 0.5% I.V.	Norbar 20215.ETS
Torque Transducer	0-2000 lb-ft	± 0.5% I.V.	Norbar 20540.ETS
Torque Transducer	0-100 lb-in	*± 0.1% I.V.	AKO TSD011
Torque Transducer	0-100 lb-ft	*± 0.1% I.V.	AKO TSD111
Torque Transducer	0-2000 lb-ft	*± 0.1% I.V.	AKO TSD2010
Torque Transducer	4-50 lb-in	± 0.25% I.V.	CDI 2000-400-02
Torque Transducer	30-400 lb-in	± 0.25% I.V.	CDI 2000-400-02
Torque Transducer	80-1000 lb-in	± 0.25% I.V.	CDI 2000-400-02
Torque Transducer	20-250 lb-ft	± 0.25% I.V.	CDI 2000-400-02

\*± One least significant digit