

# Certificate of Accreditation



**Cascade Engineering Services, Inc.**

**Metrology Laboratory**

**2515 140<sup>th</sup> Ave., NE**

**Bellevue WA 98005**

having satisfactorily demonstrated conformance to the requirements of

**ISO/IEC 17025:2005**

and technical competence for the activities identified on the attached schedule,

**TUV Rheinland of North America, Inc.**

hereby grants accreditation for the following activities:

**Calibration**

Initial Approval: April 4, 2003

Current Approval: January 23, 2007

Current Expiration: August 31, 2008

**Accreditation Certificate 74 400 2040**

Revision: 6

A handwritten signature in black ink, appearing to read 'Dave Moody', written over a horizontal line.

Dave Moody – Program Manager

Laboratory Accreditation Services

Youngsville NC

# Schedule of Accreditation



## Cascade Engineering Services, Inc. Metrology Laboratory

Bellevue WA

Accreditation Certificate 74 400 2040

Revision: 6

Parameter	Range	Uncertainty <sup>1</sup>	Notes		
			Resolution	Technique	Location
<b>DC Volts – Source</b>					
	0 to ±1100 V	3.22e + 00 ppm	3.11e – 02 ppm	5720A	CES/Mobile
<b>DC Volts – Measurement</b>					
	0 to ± 1050 V	1.92e + 01 ppm	1.40e – 02 ppm	3458A	CES/Mobile
<b>AC Volts – Source</b>					
≤ 100 KHz	0 to 1100 V	3.50e + 02 ppm	2.41e – 01 ppm	5720A	CES/Mobile
> 100 KHz	0 to 1100 V	2.16e + 03 ppm	2.41e – 01 ppm		
<b>AC Volts – Measurement</b>					
1 Hz to ≤ 2 MHz	0 to 700 V	2.25e + 03 ppm	1.23e – 01 ppm	3458A	CES/Mobile
> 2 MHz	0 to 700 V	3.06e + 04 ppm	1.23e – 01 ppm		

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			Resolution	Technique	Location
<b>DC Current – Measurement</b>					
	0 to ± 1.05 A	2.30e + 01 ppm	7.25e – 01 ppm	3458A	CES/Mobile
<b>DC Current – Source</b>					
	0 to 2.2 A	1.70e + 01 ppm	2.27e + 01 ppm	5720A	CES/Mobile
	3 to 20.5 A	2.14e + 02 ppm	7.82e + 00 ppm	5520A-PQ	
<b>AC Current – Measurement</b>					
10 Hz – 100 kHz	0 to ± 1.05 A	5.94e + 02 ppm	1.25e + 00 ppm	3458A	CES/Mobile
<b>AC Current – Source</b>					
≤ 10 kHz	0 to 2.2 A	1.49e + 02 ppm	4.55e – 00 ppm	5720A	CES/Mobile
45 Hz – 5 kHz	3 to 20.5 A	6.52e + 02 ppm	3.75e + 00 ppm	5520A-PQ	
<b>Amplitude – Source</b>					
	DC V, 1 MΩ Load	3.65e + 02 ppm	9.03e + 01 ppm	5820A-1C-GHz	CES/Mobile
	DC V, 50 Ω Load	1.49e + 03 ppm	8.19e + 01 ppm		

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Parameter	Range	Uncertainty <sup>1</sup>	Notes		
			Resolution	Technique	Location
<b>Wave Generator, 50 Ω load – source</b>					
Square 0.01 Hz – 100 kHz	1.8 mV p-p – 2.5 V p-p	1.30e + 04 ppm	4.29e + 02 ppm	5820A	CES/Mobile
Sine 0.01 Hz – 100 kHz	1.8 mV p-p – 2.5 V p-p	1.29e + 04 ppm	4.29e + 02 ppm		
Triangle 0.01 Hz – 100 kHz	1.8 mV p-p – 2.5 V p-p	1.30e + 04 ppm	4.29e + 02 ppm		
<b>Wave Generator, 1 MΩ load – source</b>					
Square 0.01 Hz – 100 kHz	1.8 mV p-p – 55 V p-p	1.30e + 04 ppm	2.56e + 02 ppm	5820A	CES/Mobile
Sine 0.01 Hz – 100 kHz	1.8 mV p-p – 55 V p-p	1.26e + 04 ppm	2.56e + 02 ppm		
Triangle 0.01 Hz – 100 kHz	1.8 mV p-p – 55 V p-p	1.25e + 04 ppm	2.56e + 02 ppm		
<b>Leveled Sine Flatness – Source</b>					
Relative to 50 kHz; 50 kHz – 600 MHz	5 mV p-p – V p-p	1.52e + 04 ppm	1.23e + 03 ppm	5820A	CES/Mobile
Relative to 10 MHz; 10 MHz – 2.1 GHz	5 mV p-p – 3.5 V p-p	2.02e + 04 ppm	1.23e + 03 ppm		

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			Resolution	Technique	Location
<b>Time Marker – Source</b>					
	500 ps – 5 s	2.07e + 12 ppm	2.76e – 02 ppm	5820A	CES/Mobile
<b>Resistance – Source</b>					
1 and 1.9, 10x Steps	0 – 100 MΩ	1.59e + 01 ppm	2.25e – 01 ppm	5720A	CES/Mobile
	0 – 120 MΩ	1.15e + 02 ppm	5.90e – 01 ppm	3458A	CES/Mobile
<b>Inductance – Source</b>					
@ 1.00 kHz, 10 mV	1 mH – 10 mH	3.42e + 03 ppm		1491D	CES/Mobile
@ 500 Hz, 20 mV	10 mH – 100 mH	1.10e + 04 ppm		1491D	CES/Mobile
@ 200 Hz, 20 mV	100 mH – 1 H	4.85e + 03 ppm		1491D	CES/Mobile
@ 100 Hz, 40 mV	1 H – 10 H	5.67e + 03 ppm		1491D	CES/Mobile

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Parameter	Range	Uncertainty <sup>1</sup>	Notes		
			Resolution	Technique	Location
<b>Capacitance – Source</b>					
1 kHz – 13 MHz	1pF	5.46e + 03 ppm		16380	CES/Mobile
1 kHz – 13 MHz	10pF	1.50e + 02 ppm		16380	
1 kHz – 13 MHz	100pF	1.40e + 03 ppm		16380	
1 kHz – 13 MHz	1000pF	1.27e + 04 ppm		16380	
	1.1 nF – 1.1 µF	2.36e + 03 ppm	4.09e + 01 ppm	5520A-PQ	CES/Mobile
@100 Hz	1 µF – 1 F, x10	5.23e + 02 ppm		1417	CES/Mobile
@120 Hz	1 µF – 1 F, x10	5.30e + 02 ppm		1417	CES/Mobile
@1 kHz	1 µF – 10 mF, x10	5.33e + 02 ppm		1417	CES/Mobile
<b>RF Power – Source</b>					
100 kHz – 4.2 GHz	1 mW Nominal	1.00e + 02 ppm		F1119C / 1805B	CES
0.01 GHz – 18.0 GHz	1 mW Nominal	1.00e + 02 ppm		1807A / 1805B	CES

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Parameter	Range	Uncertainty <sup>1</sup>	Notes		
			Resolution	Technique	Location
<b>Attenuation dB – Measurement</b> 0 – 127 dB		3.08e + 03 ppm		8902A/11722A	CES/Mobile
<b>Amplitude Modulation % – Measurement</b> 20 Hz – 100 kHz	0 – 99% AM	2.30e + 03 ppm		8902A/11722A	CES/Mobile
<b>Frequency Modulation Hz – Measurement</b> 250 kHz – 1.3 GHz	20 Hz – 200 kHz	5.80e + 04 ppm		8902A/11722A	CES/Mobile
<b>Phase Modulation - Measurement</b> 200 Hz – 20 kHz	0 – 400 radians	5.00e + 04 ppm		8902A/11722A	CES/Mobile
<b>VSWR – Measurement</b> 5 MHz – 2 GHz	40dB Directivity	±0.008 – 0.07 VSWR		60S50	CES/Mobile
2 GHz – 18 GHz	35dB Directivity	±0.008 – 0.07 VSWR		87A50	CES/Mobile
<b>Frequency – Source, Measurement</b> Loran C	0.1 Hz – 26.5 GHz	1.00e – 07 ppm		FS700	CES
GPS	0.1 Hz – 26.5 GHz	1.00e – 07 ppm		58503A	CES/Mobile

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			Resolution	Technique	Location
<b>Dimensional – Measurement, Standard</b>					
	0.02 – 14 internal	2.83e + 01 ppm	3.57e - 03 ppm	Labmaster	CES
	0 – 13 external	2.83e + 01 ppm	3.57e - 03 ppm		
<b>Dimensional – Source, Standard</b>					
	0.05 in – 4.0 in	3.46e + 01 ppm	0.0001 in steps	516-401-22	CES/Mobile
	5 in, 6 in, 7 in, 8 in, 10 in, 12 in, 16 in, 20 in	5.40e + 00 ppm		SS8A1X	CES/Mobile
<b>Mass – Source</b>					
Class F Dead Weight	0.5 lb – 50 lb	2.56e+01 ppm			CES/Mobile
Class C Dead Weight	1/32 oz – 2 lb	1.00e+02 ppm			CES/Mobile
Class 3 Dead Weight	0.01 g – 200 g	5.01e+01 ppm			CES/Mobile
<b>Fiber Optics – Power</b>					
5 to 0 60 dBm	750 – 1000 nm	2.50e – 02 ppm	0.001 dBm	IQS–1502 Power	CES
	1000 – 1700 nm	2.50e – 02 ppm	0.001 dBm		
	1700 – 1800 nm	3.00e – 02 ppm	0.001 dBm		

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			Resolution	Technique	Location
<b>Pressure – Source, Measurement</b>	0 to -15 psi	1.32e+02 ppm		DPI 605	CES/Mobile
<b>Pressure – Source</b>	10 – 4000 psi	1.84e+02 ppm		M1900/3	CES/Mobile
<b>Humidity – Measurement</b>	0 – 100% RH	1.21e+02 ppm		HMI41/HMP46	CES/Mobile
<b>Speed Measuring Devices</b>					
Range	0 – 300 ft		0.125"	MET 1261	CES/Mobile
Frequency	0 – 35 GHz		0.001 GHz	VOCAR HR	CES/Mobile

**Notes**  
1 Best uncertainty determined with a coverage factor of k = 2.

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