NASA ROCKET PROPULSION TEST (RPT) OFFICE

Calibration Laboratory Capabilities
Listing as of April 2009

Centers Providing Information:

GLENN RESEARCH CENTER AND PLUM BROOK TEST FACILITY

KENNEDY SPACE CENTER

MARSHALL SPACE FLIGHT CENTER

STENNIS SPACE CENTER

WHITE SANDS TEST FACILITY

Prepared by
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4/27/09

GLENN RESEARCH CENTER AND PLUM BROOK TEST FACILITY (Honeywell)

Honeywell Manager, Perry LaRosa, 216-977-7224
NASA Representative; Eiter Reyes, 216-433-6469

ALTERNATING CURRENT		
Parameter	**Range**	***Instrument Uncertainty**
AC Current	10 ma (10 Hz to 50 kHz)	±0.013%
	20 mA (10 Hz to 20 kHz)	±0.018%
	30 mA (10 Hz to 20 kHz)	±0.018%
	50 mA (20 to 50 kHz)	±0.028%
	100 mA (20 to 50 kHz)	±0.028%
	200 mA (50 to 100 kHz)	±0.018%
	300 mA (50 to 100 kHz)	±0.018%
	500 mA (50 to 100 kHz)	±0.018%
	1 A (50 to 100 kHz)	±0.018%
	2 A (50 to 100 kHz)	±0.018%
	3 A (50 to 100 kHz)	±0.018%
	5 A (10 Hz to 20 kHz)	±0.028%
	10 A (10 Hz to 20 kHz)	±0.028%
	20 A (20 to 50 kHz)	±0.028%
AC ratio	1:1 to 1:0.001	±1.0 ppm
AC voltage	600 µV to 1 kV (10 Hz to 30 MHz)	±18 ppm (best)
	0.25 to 10.0 v (30 to 100 MHz)	±0.01 to 1.4%
Capacitance	0.01 fF to 100 F (10 Hz to 2 MHz)	±0.05% (best)
Inductance (10 Hz to 2 MHz)	1 pH to 1111 H	±0.05% (best)
Phase angle (electrical) 0 to 360°	1 Hz	±0.1°
	10 Hz to 50 kHz	±0.05°
	50 to 100 kHz	±0.05 to ±0.7°
	100 kHz to 10 MHz	±0.35 to ±0.7° per 100 kHz
	10 MHz to 1.0 GHz	±1.5°

GRC

DIRECT CURRENT		
Parameter	**Range**	***Instrument Uncertainty**
DC voltage	10 nV to 1100 V	<±1.0 ppm (best)
	1.1 to 10 kV	±0.01%
DC ratio	10:01	±0.2 ppm
	100:01:00	±0.5 ppm
	1.1:0.0000001	±0.1 ppm
Resistance	0.001 to 0.1 ohm	<±10 ppm
	1.0 ohm	<±0.2 ppm
	10 K ohm	<±0.6 ppm
	1 to 10 K ohm	<±1.0 ppm
	10 K to 100 M ohm	<± 0 ppm
	100 M to 1 T ohm	<±0.2%
	1 T to 10 T ohm	±0.5%
MASS, FORCE, TORQUE		
Parameter	**Range**	***Instrument Uncertainty**
Mass	1 mg to 32 kg	SD ±0.02 mg to ±0.3 g LIN ±0.03 mg to ±0.5 g
Force	0 to 1000 lbf deadweight	±0.01%
	100 lbf to 100 Klbf proving rings	0.03%
	5 to 50 Klbf load cells	±0.038% reading absolute
Torque	0.0035 to 1.518 NM (0.5 to 215 in. oz.)	±0.2% rdg.
	2.26 to 1356 NM (20 in. lb. to 1000 ft. lb.)	±0.1% F.S.
PRESSURE AND VACUUM		
Parameter	**Range**	***Instrument Uncertainty**
Pressure/static	1.37 to 172.37 KPa (0.2 to 25 psi)	±35 ppm
	11.72 to 689.48 KPa (1.7 to 100 psi)	±35 ppm
	13.79 K to 6.89 MPa (2.0 to 1000 psi)	±35 ppm
	6.89 to 13.79 MPa (1000 to 2000 psi)	±81 ppm
	41.37 K to 82.74 MPa (6 to 12,000 psi)	±81 ppm
Vacuum	0.1 to 1 torr A	±0.06% Rd ±1 count
	1 to 10 torr A	±0.06% Rd ±1 count
	1 to 10 torr D	±0.06% Rd ±1 count
	10 to 100 torr A	±0.06% Rd ±1 count
	100 to 1000 torr	±0.01% F.S.

GRC

SAFETY (GAS)		
Parameter	**Range**	***Instrument Uncertainty**
Helium leak rate	5.9×10^{-9} to 6.2×10^{-8} scc/s	±3.0% °C
Gas analysis	(Check for changes)	
Oxygen	0 to 21%	Call Flow Laboratory (216–433–5941)
CO_2 in N_2	2.0 to 14% concentration	±0.0022 mole to 0.14 mole%
CO in N_2	50 to 5000 ppm	±0.5 to 50.0 ppm
C_3H_8 in air	3.0 to 500 ppm	±0.03 to 4.0 ppm
NO in N_2	97 ppm to 942 ppm	±0.7 to 9.0 ppm
Residual hydrocarbon	0 to 5.0 ppm	±3.0 cm^{-3} 0.05 ppm
THERMODYNAMIC		
Parameter	**Range**	***Instrument Uncertainty**
Temperature (ITS 90) Fixed points and SPRTs –195.794° C to 660.323° C	WTP 0.01° C	±0.2 mK
Dew point/relative humidity	–45° C to 60° C	±0.2 C
	<1 to 100%	±0.5% RH
Liquid Flow	0.01 to 285 gpm H_2O weight-time calibrator	±0.20%
	1 to 600 pph weight-time calibrator Stoddard solvent	±0.25%
	0 to 2.5 gpm turbine meter Xfer standard	±1.5%
Gas Flow	1.0 sccm to 50 slpm volume displacement (5)	±0.20%
	0.6 to 4.0 pps sonic nozzles (8)	±0.5%
	0.0003 to 3.5 pps orifices (6)	±0.5%
	3.5 to 30 pps venturi (2)	±0.25%

*Instrument uncertainties not measurement uncertainties

KENNEDY SPACE CENTER (EG&G)

EG&G Manager; Perry King, 321-494-2504
NASA Representative: Scott Mimbs, 321-861-5184

ALTERNATING CURRENT		
Parameter	**Range**	**Best Measurement Uncertainty (k=2)**
AC Voltage	0.6 V to 1000 V rms 10 Hz to 1 MHz	10 ppm
	2 mV to 600 mV 10 Hz to 1 MHz	25 ppm to 5000 ppm
	0.5 V to 1000 V 10 Hz to 1 MHz	5 ppm to 150 ppm
	0.25 V to 50 V 100 Hz to 100 MHz	0.005 % to 1.2 %
	1.0 V to 7.0 V 10 MHz to 7.0 GHz	1.5 %
AC Voltage Ratio	0.0001:1 to 1:1	1 ppm
AC Current	100 µA to 100 A rms 10 Hz to 50 kHz	50 ppm to 100 ppm
Phase – Measure	0° to 360° 10 mV_{RMS} to 350 V_{RMS}	±200 m°; 5 Hz to 10 Hz ±50 m°; 10 Hz to 50 kHz <150 m° to 100 kHz <1.5° to 500 kHz
Phase - Source	0° to 1000° 100 mV_{RMS} to 100 V_{RMS}	±5 m°; 1 Hz to 1 kHz ±10 m°; 1 kHz to 6.3 kHz ±25 m°; 6.3 kHz to 50 kHz ±50 m°; 50 kHz to 100 kHz
Capacitance	10 pF 20 Hz to 20 kHz	0.5 ppm
	100 pF 20 Hz to 20 kHz	0.5 ppm
	1000 pF 20 Hz to 20 kHz	5.0 ppm
	10^{-19}F to 10^{-6} F 20 Hz to 20 kHz	5 to 70 ppm + 1 aF
Inductance Freq Range: 12 Hz to 100 kHz Dependent upon inductance level.	100 µH	0.10 %
	1 mH	0.02 %
	10 mH	0.02 %
	100 mH	0.02 %
	1 H	0.02 %
	10 H	0.05 %
Frequency	1, 5, and 10 MHz	2 x 10^{-12}
Magnetic Field Strength	100, 200, 500, 1k, 2k, 5k, 10k Gauss	1.0 % to 1.9 %
	100, 200, 500, 1k, 2k Gauss	1.3 % to 2.1 %

KSC

DIMENSIONAL		
Parameter	**Range**	**Best Measurement Uncertainty (k=2)**
Length	125 to 500 mm	0.15 to 0.35 μm
	0.01 to 4.0 inch (0.2 to 101.6 mm)	3 to 4 μin (0.08 to 0.10 μm)
	5 to 12 inch (127 to 305 mm)	5 to 7 μin (0.13 to 0.18 μm)
	16 to 20 inch (406 to 508 mm)	8 to 10 μin (0.20 to 0.25 μm)
	0.001 to 8 inch (0.25 to 203 mm)	20 μin (0.5 μm)
	8 to 16 inch (203 to 406 mm)	30 μin (0.75 μm)
	16 to 48 inch (0.4 to 1.2 m)	40 μin (1.0 μm)
	12 to 600 inch	0.003 to 0.008 inch
	600 to 1200 inch	0.008 to 0.013 inch
Inside Diameter	0.2 to 12 inch (5 to 304.8 mm)	10 μin (0.25 μm)
	12 to 16 inch (305 to 406 mm)	30 μin (0.76 μm)
Outside Diameter	0.100 to 1.000 inch (2.54 to 25.4 mm)	10 to 30 μin (0.25 to 0.76 μm)
Flatness	Optical Planes to 152 mm (6 in) in diameter	0.05 to 0.08 μm (2 to 3 μin)
	Surface Plates to 3 m (10 ft)	0.5 to 2.54 μm (20 to 100 μin)
Angle	0 to 30 arc minutes	0.1 to 0.5 arc seconds
	0 to 360°	0.2 to 1.0 arc second
Optical Alignment	0.5 to 30.5 m (1.5 to 100 ft)	1.0 arc second
Surface Roughness	0.05 to 4.1 μm Ra (2 to 160 μin Ra)	0.05 to 0.15 μm (2 to 6 μin)

KSC

DIRECT CURRENT		
Parameter	**Range**	**Best Measurement Uncertainty (k=2)**
DC Voltage	0 V to 10 V	0.02 ppm
	10 V to 100 V	0.5 ppm
	100 V to 1000 V	2.0 ppm
	1000 V to 100 kV	100 ppm
DC Voltage Ratio	0.1 to 1.0	0.1 ppm + 0.15 μV
	10:1	0.2 ppm
	100:1	0.5 ppm
DC Current	0 A to 10 A	10 ppm
	10 A to 30 A	25 ppm
	30 A to 100 A	100 ppm
DC Resistance	10^{-3} Ω 100 Amps max	7 ppm
	10^{-2} Ω	5 ppm
	10^{-1} Ω	3 ppm
	1 Ω	0.15 ppm
	10 Ω	0.2 ppm
	100 Ω	0.4 ppm
	1000 Ω	0.6 ppm
	10^{4} Ω	0.3 ppm
	10^{5} Ω	0.8 ppm
	10^{6} Ω	2 ppm
	10^{7} Ω	10 ppm
	10^{5} Ω to 10^{11} Ω	0.25 % to 0.1 %
	10^{11} Ω to 10^{13} Ω	0.2 % to 1 %

KSC

MASS, FORCE, TORQUE		
Parameter	**Range**	**Best Measurement Uncertainty (k=2)**
Mass	1 mg to 1 g	0.001 mg to 0.01 mg
	1 g to 100 g	0.01 mg to 0.035 mg
	100 g to 1000 g	0.035 mg to 0.050 mg
	2 kg to 10 kg	1.0 mg to 3.5 mg
	10 kg to 25 kg	10 mg to 20 mg
	25 kg to 30 kg	40 mg
	30 kg to 60 kg	40 mg to 70 mg
Force	50 to 1000 lbf (222 to 4448 N)	0.008 % of applied load
	2, 5.5, 10 klbf (9, 24, 44 kN)	0.004 % of Range
	25, 50, 100 klbf (111, 222, 444 kN)	0.005% of Range
Torque	20 to 100 in ozf (0.14 to 0.17 N·m)	0.25 % of Range
	2 to 20 in lbf (0.23 to 2.26 N·m)	0.1 % of Range
	20 to 100 in lbf (2.26 to 11.3 N·m)	0.1 % of Range
	10 to 100 ft lbf (13.6 to 135.6 N·m)	0.1 % of Range
	100 to 1000 ft lbf (135.6 to 1355.8 N·m)	0.1 % of Range
	1000 to 4000 ft lbf (1356 to 5423 N·m)	0.1 % of Range
RPM	5 to 250 RPM	0.02 RPM
	250 to 5000 RPM	0.25 RPM
	5000 to 25,000 RPM	1.55 RPM

MISCELLANEOUS		
Parameter	**Range**	**Best Measurement Uncertainty (k=2)**
Sound Pressure Level	50 Hz to 4 kHz 74 to 114 dB	0.3 dB
Microphone Sensitivity (1/2" & 1")	50 Hz to 4 kHz	0.1 dB
Vibration Pickup Sensitivity	10 Hz to 10 kHz 1 g to 10 g rms	1.5 %
Gas Detectors – By Test Gas (Uncertainties are the Expanded Uncertainties of the Standard Gases)		
Oxygen (O_2)	0% to 24% O_2	±0.02% O_2
Carbon Monoxide (CO)	90 ppm CO	±1% of Component (0.9 ppm)
Carbon Dioxide (CO_2)	4000 ppm CO_2	±1% of Component (40 ppm)
Hydrogen Sulfide (H_2S)	25 ppm H_2S	±1% of Component (0.25 ppm)
Methane (CH_4)	2.5% CH_4 (50% LEL)	±0.02% CH_4
Isobutylene (C_4H_8)	100 ppm (C_4H_8)	±1% of Component (1 ppm)
Pentane ($C_5H_{10)}$	0.8% C_5H_{10}	±1 % of Component (0.008%)
Halon 1301	500 ppm Halon 1301	±2% of Component (10 ppm)
Hydrogen (H_2)	4000 ppm (H_2)	±2% of Component (80 ppm)
PH Meters	4 to 10 ph	±0.01 ph
Halogen Leak Detectors (R-12)	0.2 to 5 oz/yr	±10% of leak rate
Electrolytic Conductivity	5 to 100 microSiemen/cm (µS/cm)	±0.44 µS/cm @ 5 ±0.48 µS/cm @ 10 ±0.65 µS/cm @ 100
Particle Counters	0.5 µm and 5.0 µm	±0.04 µm
Hydrocarbon Cleaning (Pressure and Flow)	Level A (< 1 mg/100 ml)	N/A
Particulate Cleaning (Pressure and Flow)	Level 50 (none > 50 microns)	N/A

KSC

PHOTOMETRIC, RADIOMETRIC, FIBER OPTIC		
Parameter	**Range**	**Best Measurement Uncertainty (k=2)**
Luminous Intensity	50 cd to 1600 cd	1.8 %
	969 cd	0.72 %
Illuminance	50 lx to 3800 lx	0.7 %
Luminance	25cd/m^2 to 1900 cd/m^2	2.7 %
Spectral Radiometry	250 nm to 1600 nm 0.2 W/cm^3 to 240 W/cm^3	2 to 5 %
Detector Spectral Response	300nm to 1100 nm 0.5 µW to 10 µW	1 to 4.5 %
Fiber Optic Power	850, 1310, & 1550 nm -60 dBm to 0 dBm	2 %
Fiber Optic Attenuation	Up to 40 dB @850 nm	1 %
	Up to 60 dB @1310 nm (to 1 nW)	0.2 % (0.01 dB)
	Up to 60 dB @1550 nm	0.5 %
Fiber Optic Wavelength	400 nm to 1600 nm	0.1 nm

PRESSURE AND VACUUM		
Parameter	**Range**	**Best Measurement Uncertainty (k=2)**
Pressure (Static)	0 to 15 kPa (0 to 2.175 psi)	30 ppm Rdg + 25 mPa
	0 to 224 kPa (0 to 32.5 psi)	40 ppm or 0.0012 in Hg
	2 to 350 kPa (0.29 to 50.8 psi)	12 ppm + 0.02 Pa
	5 to 1000 kPa (0.73 to 145 psi)	17 ppm
	10 to 1750 kPa (1.5 to 250 psi)	14 ppm + 0.1 Pa
	40 to 7000 kPa (5.8 to 1000 psi)	20 ppm + 0.2 Pa
	0.2 to 16 MPa (29 to 2320 psi)	31 ppm
	0.2 to 100 MPa (29 to 14.5 kpsi)	33 ppm
	0.4 to 200 MPa (58 to 29 kpsi)	41 ppm
	1.0 to 500 Mpa (145 to 72.5 kpsi)	63 ppm
Vacuum	10^{-6} Torr to 10^{-3} Torr ($1.33x10^{-4}$ to 0.133 Pa)	2.0 % of Reading
	$7.5x10^{-5}$ Torr to 110 Torr (0.01 to 15 kPa)	30 ppm Rdg + 25 mPa
	0.001 Torr to 5000 Torr (0.133 Pa to 666 kPa)	0.6 % of Reading

KSC

THERMODYNAMIC		
Parameter	**Range**	**Best Measurement Uncertainty (k=2)**
Temperature (ITS-90, IPTS-68)	-195.8 °C	0.0025 °C
	-38.8344	0.0012 °C
	0.0100 °C	0.0003 °C
	29.7646 °C	0.0012 °C
	156.5985 °C	0.0014 °C
	231.9280 °C	0.0020 °C
	419.5270 °C	0.0020 °C
	660.3230 °C	0.0070 °C
	961.7800 °C	0.0346 °C
	0 to 1100 °C	0.5 °C
Temperature Sensors	-50 to +450 °C	0.010 °C
Relative Humidity	5 to 99 % RH	0.3 % RH
Dew Point	0.05 to 12000 ppm V (-95 to +10°C)	0.0035 to 84 ppm V (0.1 °C)
Dew Point (cont.)	300 to 440k ppm V (-35 to +70°C)	2 to 1126 ppm V (0.04 °C)
Infrared Radiation	35°C to 500°C	2.0 °C
	500°C to 1000°C	4.5 °C
Helium Leak	$9.6x10^{-11}$ to $1.2x10^{-13}$ mol/s ($2.1x10^{-6}$ to $2.7x10^{-9}$scc/s)	3%
Gas Flow - Air	10 SCCM to 40 SLPM	0.35% of Reading
	40 to 5663 SLPM (1.413 to 200 SCFM)	0.7% of Reading
	200 to 2000 SCFM	1% of Reading
Gas Flow – Nitrogen (GN_2)	2 SCCM to 40 SLPM	0.35% of Reading
	40 to 5663 SLPM (1.413 to 200 SCFM)	0.7% of Reading
Gas Flow – Helium (GHe)	10 SCCM to 50 SLPM	0.35% of Reading
	40 to 5663 SLPM (1.413 to 200 SCFM)	0.7% of Reading
Gas Flow –	29.5 to 59 FPM	2.5% of Reading
Air Velocity	59 to 246 FPM	1.5% of Reading
	246 to 591 FPM	1.75% of Reading
	591 to 1969 FPM	1.5% of Reading
	1969 to 8000 FPM	1% of Reading

MARSHALL SPACE FLIGHT CENTER (ERC)

ERC Manager: Brian MacDonald, 256-544-3956

NASA Representative: Gary W. Kennedy, 256-544-3861, cell 256-724-1962

ALTERNATING CURRENT		
Parameter	**Range**	***Instrument Uncertainty**
Voltage (AC)	0.5 to 1000 V (400 Hz to 20KHz)	0.0002
	0.25 to 1000V 20 KHz to 30 MHz	0.0005
	1000 to 1100 V (20 KHz to 10 KHz)	0.0005
Current (AC)	2.5 mA to 10 A (10Hz to 10 KHz)	0.0005
Capacitance	10 nF to 1 µF	0.0001
	1 µF to 11 µF	0.0005
	1000 pF	25 ppm
Inductance	0.01 mH to 111 mH	Typically ± 0.1%
	111 mH to 1.111 mH	Typically ± 0.1%
	50 mH to 10 H	Typically ± 0.1%
Frequency	1 MHz, 5 MHz, 10 MHz	9 part in 10^{12}
	1 µHz to 1 GHz	3×10^{-7}
Frequency (Deviation)	20 Hz to 200 KHz	5%
Frequency (Response)	2.5 MHz to 1300 MHz (-120 to 0 dBm)	0.01 dB per dB change
RF-Voltage	1 mV to 3.0 V (20 to 50 KHz)	±0.01
	1 mV to 3.0 V (50 to 100 KHz)	±0.05
	1 mV to 3.0 V (0.1 to 60 Hz)	±0.03
RF-Distortion	5 Hz to 600 KHz	0.03 Hz

MSFC

DIMENSIONAL		
Parameter	**Range**	***Instrument Uncertainty**
Angle	0 to 360°	± 5.0 arc-sec
	0 to 45°	± 12.7 mm
Length	0-1 meter	± 0.025% rdg
	0 to 101.6 mm	± 0.5 mm
	0.10 to 2.03 mm	± 1.27 mm
Length Internal	0.02 to 14”	2×10^{-6}
Length External	0 to 13”	2×10^{-6}
Thread (pitch diameter)	0 to 15.24 cm	± 2.54 mm
Rings	0 to 80 TPI	W tol as per H-28
Hardness	B, C, F, H, 30N, 30T, Vicker5 scales	± 2%
Displacement	0 to 6 inch	.025 % rdg
	0 to 39 inch	.025% rdg
DIRECT CURRENT		
Parameter	**Range**	***Instrument Uncertainty**
Voltage (DC)	10 V	±0.6 ppm
	0.1 to 1000 V	±1.2 ppm
	1 to 100 mV	±1.2 ppm
Current (DC)	0.1 mA to 10 A	0.0001
	0.1 to 100 A	0.001
Resistance	1 mΩ to 1×10^{9} Ω	0.3 ppm to 20 ppm
	10^{10} to 10^{12} Ω	0.15 to 5.0%
Electrostatic Testing	Varies w/instrument	Typically ± 10%

MSFC

MASS, FORCE, TORQUE		
Parameter	**Range**	***Instrument Uncertainty**
Mass	1 mg to 1.0 g	± 10 µg
	1.0 to 20 g	± 50 µg
	20 to 100 g	± 0.0005%
	100 to 1,000 g	± 0.0005%
	1 to 5 lbs	±0.005%
	0 to 50 lbs	
Force	0 to 500 lbf	± 0.01%
	0 to 5,000 lbf	± 0.05%
	0 to 50,000 lbf	± 0.02%
	0 to 500 kip	± 0.02%
	0 to 5 M lbf	± 0.1%
Torque	0 to 2,000 ft-lb	± 0.1%

PRESSURE AND VACUUM		
Parameter	**Range**	***Instrument Uncertainty**
Pressure: (Static) (Hydraulic) (Dynamic) (Pneumatic)	0 to 600 psi	± 0.012%
	6.0 to 40,000 psi	± 0.06%
	0 to 1,000 psi	± 0.07%
	0 to 1 psi	.004% FS
	0 to 10 psid	10 ppm
	0 to 43.5 psia	.005% FS + .005% rdg
	0 to 100 psig	10 ppm
	0 to 600 psi	.05% rdg or .01 psi
	0 to 1000 ps	.005% rdg
	0 to 6000 psi	.05% rdg or .01 psi
	0 to 6000 psi	± 0.012%/ 0.015%
	0 to 6000 psia	.01% of range (2K, 4K, 6K)
	40 to 7000 kPa	30 ppm + 2pa
	30 to 16000 psi	0.01% of rdg
(Pneumatic portable)	-14.5 to 300 psi	0.025% FS
Vacuum	10^{-3} to 1,000 torr	± 0.05%
	1×10^{-4} to 1×10^{-8} torr	± 5%

MSFC

THERMODYNAMIC		
Parameter	**Range**	***Instrument Uncertainty**
Temperature	0°C	± 0.01°C
	-38.8°C	± 1°mK
	29.8°C	± 1°mK
	156.6°C	± 2°mK
	231.9°C	± 2°mK
	419.5°C	± 2°mK
	660.3°C	± 6°mK
	961.8°C	± 30°mK
Temperature (optical)	700° to 2,400°C	± 0.5%
Temperature (furnace)	0 to 3,000°C	± 1.0%
Conductivity	45, 450, 1500, 4500m Mhos	± 2%
pH	4.00, 10.00, 7.00	± 0.02% @ 25°
Dissolved Oxygen	0 to 200%	± 0.25%
	0 to 20,000 ppm	± 50 ppm
Vibration (acceleration)	1 to 10 G 5 to 2,500 Hz	± 1.5%
	1 to 10 G 2,500 to 10,000 Hz	± 2.5%
Flow (liquid)	0.001 to 300 gpm	± 0.2%
	0 to 3,000 gpm	± 0.28%
	0.4 to 400 gpm	± 0.05% of rd
Flow (gas)	1 cc/min to 10,000 cc/min	± 0.2% of rdg
	5,000 cc/min to 1 x 10^6 cc/min	± 0.2% of rdg
	1 cc/min to 24,000 cc/min	± 0.35%
	15 to 200 CFM	± 0.6%

*Instrument uncertainties not measurement uncertainties

STENNIS SPACE CENTER (AGT)

AGT Manager, Kirk Foster, Phone: 228-688-1844
NASA Representative: Bruce Farner, 228-688-2619

ALTERNATING CURRENT		
Parameter	**Range**	**Best Uncertainty**
AC Current	10 A to 100 A DC to 1 kHz	± 0.1 %
AC Current	10 mA to 2 A 10 Hz to 5 kHz	± 120 ppm
AC Current	2 A to 20 A 1kHz to 10 kHz	± 25 ppm
AC Voltage	0.5 to 40 V @ 10Hz to 10 MHz	± 7 to 1600 ppm
AC Voltage	0.5 to 40 V @10 Hz to 1 MHz	± 7 to 107 ppm
AC Voltage	350 mV to 40 V @10 Hz to 1 MHz	± 20 to 500 ppm
AC Voltage	40 to 1200V @ 10 Hz to 100 KHz	± 20 to 520 ppm
AC Voltage	50 to 1200 V @ 10 Hz to 100KHz	± 9 to 50 ppm
Capacitance	1 pF to 1.111mF	± 10 ppm @1 kHz
Capacitance	100 pF	± 20 ppm @100 Hz ± 10 ppm @1 kHz
Capacitance	1000 pF	± 10 ppm @100 Hz ± 20 ppm @1 kHz
Inductance	0.1 mH to 99,999 H	± 0.12% @100 Hz and 1 kHz
Inductance	1 H	± 0.030% @100 Hz, ± 0.080% @1 kHz
Inductance	1 mH	± 0.035% @100 Hz, ± 0.038% @1 kHz
Inductance	10 H	± 0.032% @100 Hz, ± 0.032% @1 kHz
Inductance	10 mH	± 0.032% @100 Hz, ± 0.032% @1 kHz
Inductance	100 mH	± 0.032% @100 Hz, ± 0.033% @1 kHz
Inductance	100 mH	± 0.167% @100 Hz, ± 0.152% @1 kHz
Magnetics, Axial & Transverse	311 to 10,000 gauss	± 3%
Phase Angle	0 to 360°	± 0.01°
Ratio, AC	1:001 to 1:1 @ 1 kHz	± 0.5 ppm
Risetime	< 70 pSec	± 6pS
Risetime	25 pSec	± 6pS
RF Attenuation	0 to -120 db 10 MHz to 18 GHz	± 0.02 db
RF Power	0 to 50 Watts @ 10 to 1000 MHz	± 0.5% of reading

SSC

DIMENSIONAL		
Parameter	**Range**	**Best Uncertainty**
Angle, Fixed	0° to 90° in 1arc second steps	± 0.18 arc seconds
Angle, Variable, X-Axis	0° to 360° in 1°	± 0.14 arc seconds
Angle, Variable, Y-Axis	-200 to 200 arc-minutes	± 5 arc-seconds
Angle, Variable, Y-Axis	Any 5 arc-minute range	± 0.5 arc-seconds
Flatness	0.05 to 6 inches	± 1 microinches
Flatness, Surface Plate	0.0 to 1000 sec	± 4 and ± 20 seconds
Length	0 to 80 inches(0 to 2.032m)	± 50 microinches absolute or ± 20 microinches when used with corrections
Length	0.05 to 1 inch	± 2 microinches typical
Length	0.25 to 14 inches Inside	± 10 microinches
Length	0.5 to 100 mm	± 0.05 mm to ± 0.06 mm
Length	1 to 4 inches	± 4 microinches typical
Length	200 nanometers - 3 micrometers	± 0.028 micrometers
Length	4 to 20 inches	up to ± 18 microinches
Level, Optical	4 feet to Optical Infinity(500 ft realistic)	± 0.5 arc seconds
Pitch Diameter	4 to 80 pitch	± 10 microinches
Shadow and Profile	0 to 14 inches	± 0.0001 inch
Surface Finish	20 min to 125 uin	±2 to 6 microinches
Surface Hardness	ROCKWELL B&C Scales	± 1.0 unit of the ROCKWELL Std.
Thickness, Coating	6.3 microns to 1.75 mm	± 5%

SSC

DIRECT CURRENT		
Parameter	**Range**	**Best Uncertainty**
DC Current	1 mA to 2 A	± 10 ppm
DC Current	2 A to 20 A	± 25 ppm
DC Current	20 A to 100 A	± 0.05%
DC Voltage	0.1 V	± 1.1 ppm
DC Voltage	1.0 V	± 0.5 ppm
DC Voltage	1.018 V	± 0.5 ppm
DC Voltage	10 V	± 0.5 ppm
DC Voltage	100 V	± 1.1 ppm
DC Voltage	1000 V	± 1.1 ppm
Ratio, DC	1:1x10-7 to 1:1.1 to 1:1	± 0.1 ppm
Resistance	> 100 Megaohms	± 0.05% to 1.0%
Resistance	0.0001 ohm	± 5.0 ppm
Resistance	0.001 ohm	± 5.0 ppm
Resistance	0.01 ohm	± 2.5 ppm
Resistance	0.1 ohm	± 2.5 ppm
Resistance	1 ohm	± 1.0 ppm
Resistance	1,000 ohms	± 2.5 ppm
Resistance	1,000,000 ohms	± 3.0 ppm
Resistance	10 ohms	± 2.5 ppm
Resistance	10,000 ohms	± 1.0 ppm
Resistance	10,000,000 and 100,000,000 ohms	± 5.0 ppm
Resistance	100 ohms	± 2.5 ppm
Resistance	100,000 ohms	± 2.5 ppm
INSTRUMENTATION		
Parameter	**Range**	**Best Uncertainty**
Repair & Test	Anadex	Repair, Adjust, Test
Repair & Test	B&F	Repair, Adjust, Test
Repair & Test	Dynamics Amplifiers	Repair, Adjust, Test
Repair & Test	Pacific Amplifiers	Repair, Adjust, Test
Repair & Test	Preston Signal Conditioners	Repair, Adjust, Test

SSC

MECHANICAL		
Parameter	**Range**	**Best Uncertainty**
Acoustics, Sound Pressure Level	114 db from 20 Hz to 2.5 kHz	± 0.2 db
Flow, Gaseous	0 to 20 ft3/min	± 0.35% reading
Flow, Gaseous	0 to 50,000 cm3	± 0.2% reading
Flow, Gaseous	0 to 800 ft3/min	± 0.58% reading
Flow, Liquid	0.01 to 300 gals/min	± 0.1% reading
Fluid Density / Specific Gravity	0.001 to 2.0 g/cm3	± 0.00001 g/cm3
Force	0 to 600 lbf	± 14.3 lbf
Force	10,000 lbf	± 1.25 lbf
Force	120,000 lbf	± 30 lbf
Force	5,000 lbf	± 0.63 lbf
Force	60,000 lbf	± 7.5 lbf
Mass	1 mg to 60 kg	± 0.0036 mg to 100 mg
Mass, Portable Cal	0 - 2000 lbs.	Class S, C, and M
Torque	0.5 ozf×in to 2,000 lbf×ft	± 0.1% reading
Torque	0.5 to 215 oz-in	± 0.2% reading
Vibration	10 Hz to 10 kHz @ 10 g pk	10 to 50 Hz ±2% 50 Hz to 2 kHz ±1%, 2.0 kHz to 10 kHz ±2%
Volume - Liquid	0.001 ft3 to 1 ft3	± 2.2 x 10-7 to ± 0.024 ft3
Wind Speed	100 to 1000 fpm	± 10 fpm
Wind Speed	1000 to 15,748 fpm	± 0.7% of reading
RADIATION, IONIZING		
Parameter	**Range**	**Best Uncertainty**
Gamma Emissions	<= 1000 millirad / hour	± 7% reading
RADIATION, OPTICAL		
Parameter	**Range**	**Best Uncertainty**
Illuminance	0.1 to 1000 foot candles	± 1.5% to 5.5 %
SAFETY (GAS)		
Parameter	**Range**	**Best Uncertainty**
Carbon Dioxide Meters	3% CO2	± 0.06% CO2
Carbon Monoxide Meters	10 ppm CO	± 0.2 ppm CO
Carbon Monoxide Meters	1430 ppm CO	± 14.3 ppm CO
Carbon Monoxide Meters	20 ppm CO	± 0.4 ppm CO
Hydrogen / LEL Meters	1.0% H2 (25% LEL)	± 0.01% H2 (0.25% LEL)
Hydrogen / LEL Meters	2.0% H2 (50% LEL)	± 0.02% H2 (0.5% LEL)
Oxygen Meters	10.4% , 20.8%	0.01% O2 content ± 0.21% O2 content Intrinsic Standard
Sulphur Dioxide / Hydrogen Peroxide Meters	10 ppm SO2 or H2O2	± 0.2 ppm SO2 or H2O2

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THERMODYNAMIC		
Parameter	**Range**	**Best Uncertainty**
Humidity - Absolute	-100°F to 167°F	± 0.36° F
Humidity - Relative	15% to 95%	± 1% Relative Humidity
Moisture	0.1 to 1000 ppm	± 0.5 ppm
Pressure, Hydraulic	30 to 60,000 psig	± 0.01% Reading
Pressure, Hydraulic	6 to 12,140 psig	± 100 ppm
Pressure, Pneumatic	0 - 10,000 psig	± 0.012% of range
Pressure, Pneumatic	0 - 15,000 psig	± 0.01 or 0.025% of range
Pressure, Pneumatic	0 - 22,000 psig	± 0.01 or 0.025% of range
Pressure, Pneumatic	0 - 3000 psig	± 0.012% of range
Pressure, Pneumatic	0 - 6000 psig	± 0.012% of range
Pressure, Pneumatic	0.2 to 600 psia/psig	± 100 ppm
Pressure, Pneumatic, Portable Cal	100 inches water	± 0.05% of full scale
Pressure, Pneumatic, Portable Cal	2500, 6000 psi	± 0.025% of full scale
Pressure, Pneumatic, Portable Cal	30, 60, 100, 200, 500, 1000, 2000, 3000, 5000, and 10,000 psi ranges	± 0.1% of full scale range
Temperature	0.01° C (fixed)	± 0.0005° C
Temperature	231.928° C (fixed)	± 0.005° C
Temperature	-38.8344° C (fixed)	± 0.0005° C
Temperature	419.527° C (fixed)	± 0.010° C
Temperature	-254°C to 0°C	± 0.1° C
Temperature	-50°C to 300°C	± 0.01° C
Temperature, Portable Cal	135°F to 250°F	± 0.5° F
Temperature, Portable Cal	-40°C to 100°C	± 0.03° C
Temperature, Portable Cal	75°C to 900°C	± 1.8° C
Vacuum	0.001 to 1 Torr	From ± 2.53% @0.001 Torr to ± 0.70% @1 Torr
TIME & FREQUENCY		
Parameter	**Range**	**Best Uncertainty**
Angular Frequency(RPM)	15 to 20,000 rpm	± 0.3% range
Frequency	1 mHz to 26.5 GHz	Accuracy ± 9 x 10-12, stability 2 x 10-12
Frequency	100 kHz, 1 MHz, 5 MHz, 10 MHz	Accuracy ± 5 x 10-12, stability 2 x 10-12

WHITE SANDS TEST FACILITY (ERC)

ERC Manager: Darrell L Shoup, 505-527-6781
NASA Representative: Clifford Madrid, 575-524-5260

ALTERNATING CURRENT	
Parameter	**Range**
Voltage, AC	0.1 – 1000 V at 5 – 50,000 Hz
Current, AC	0 – 20 A at 10 – 5000 Hz
Capacitance	1nF – 1.1 µF
Frequency	0.01 Hz – 26.5 GHz
Phase Modulation	200 – 20,000 Hz at up to 26.5 GHz
Inductance	0.1 nH – 1 kH
Power	+30 – -120 dBm up to 26.5 GHz
Noise Figure	0 – 30 dB up to 18 GHz
Automatic Network Analysis	0.045 Hz – 18 GHz
Microwave Attenuation	0 – 120 dB
DIRECT CURRENT	
Parameter	**Range**
Voltage, DC	100 µV – 10 kV
Current, DC	0 – 100 A
Resistance	10 mΩ – 1GΩ
DIMENSIONAL	
Parameter	**Range**
Angularity	0 – 360 degrees
Flatness	Resolve down to 11 µin. (0.29 µm)
Length	0.01 – 36 in. (0.25 – 940 mm)
MASS, FORCE, TORQUE	
Parameter	**Range**
Mass	1 µg – 30 kg
Force	0 – 50,000 lbf (0 – 220 kN)
Torque	3 oz-in – 21,000 lb-ft (0.02 – 2800 N·m)
PRESSURE AND VACUUM	
Parameter	**Range**
Pressure	0.05 – 30,000 psi (0.34 – 206,000 kPa)
Vacuum	Atmospheric to 10-7 torr (100 µPa)
THERMODYNAMIC	
Parameter	**Range**
Gas Flow Rate	0.0008 – 200 scfm (0.37 – 90,000 cm^3/s)
Liquid Flow Rate	0.4 – 400 gpm (0.024 – 25 L/s)
Temperature	-197 – +500 °C
Humidity	20 – 90%