

Wallops Flight Facility (WFF) Environmental, Integration and Test, and Fabrication Capabilities

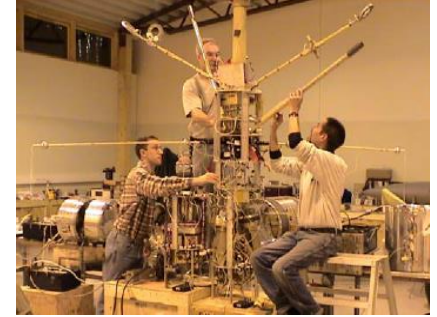
Wallops Environmental, Integration, & Testing Capabilities



Electro-Mechanical Fabrication Facility



Telemetry Ground Stations



Payload Integration Labs



Spin Balance



100K Clean Rooms & 10K Clean Tents



Thermal Vacuum Chamber



EMI/RFI Test Chamber

Vibration Test



Bend Testing

Wallops Environmental, Integration, & Testing Capabilities



Magnetic Calibration Facility



Moment-Of-Inertia Testing



Antenna Patterning Chamber



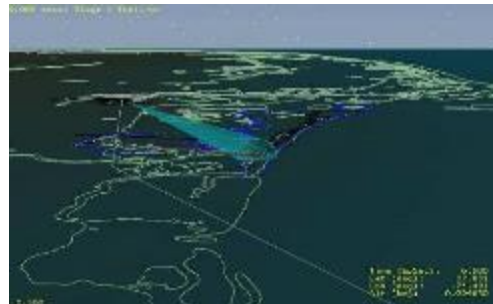
Attitude Control System Test Lab



GPS Simulation & Test Lab



Spin Deployment Facility



Mission Planning Lab



Thin Film Material Test Lab



Wallops Island Environmental, Integration & Testing Capabilities



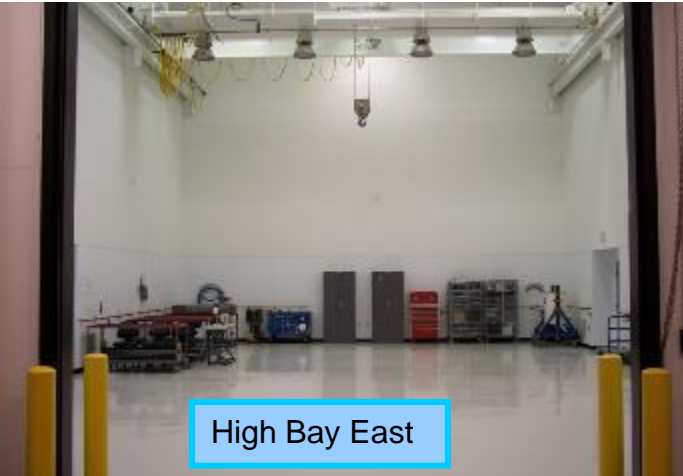
NASA WFF Multi-Purpose Payload Processing Facility Bldg F-7



EMI/EMC Facility



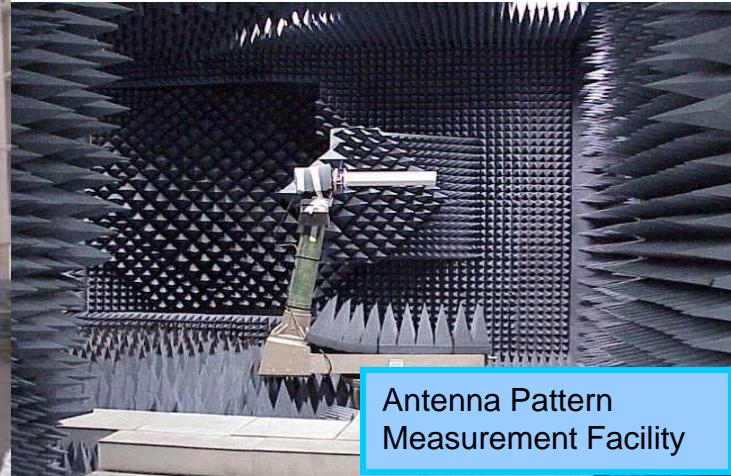
Thermal Vac Chamber



High Bay East



High Bay West

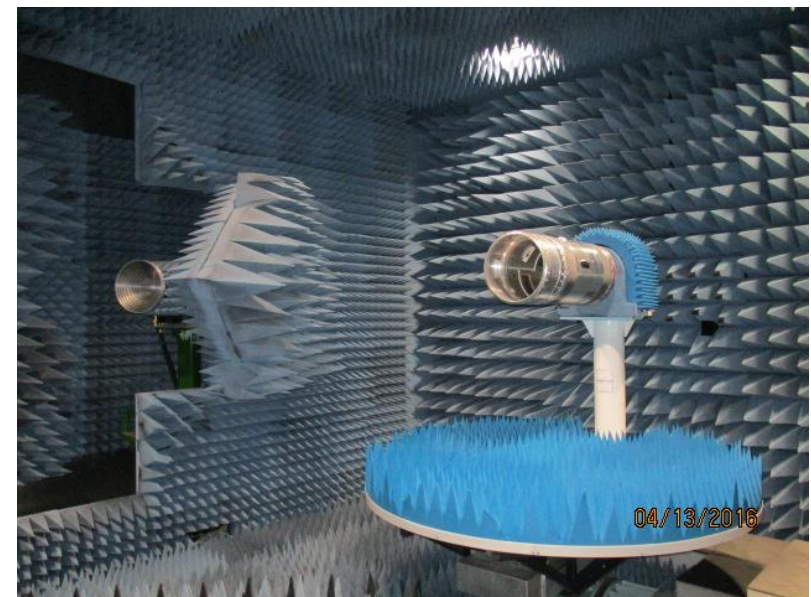
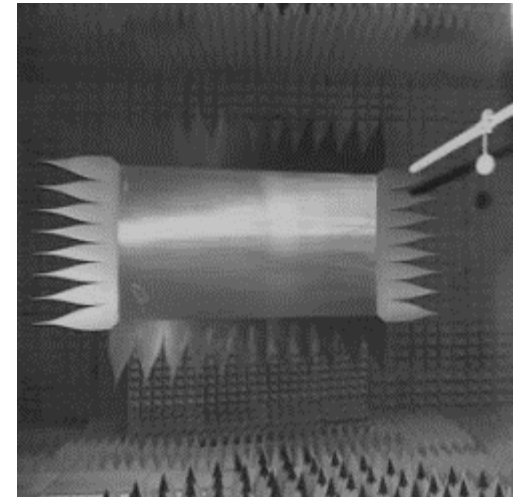


Antenna Pattern Measurement Facility

- **MIL-STD 461/462 Compliant and ANSI C63 Pre-Compliant Shielded EMI/EMC Measurement Facility for Radiated and Conducted Susceptibility and Emissions measurements.**
- **Available Tests: CE102, RE102, and RS103**
- **12 ft. Wide x 18 ft. Long Main Chamber is lined with an absorber rated up to 40GHz.**
- **Shielded (100 dB to 40 GHz) Chamber, Control Room, and Payload Support Equip. Room**
- **The chamber also provides a low noise environment that could allow for RF sensitive device characterization.**



- **A shielded Dual-Mode Far Field/Compact Range Chamber for measurement and analysis of antenna pattern data.**
 - **Far-Field mode: 400 MHz - 2 GHz frequency range.**
 - **Compact Range Mode: 2 GHz – 100+ GHz frequency range. 6'W x 6'D x 4'H elliptic cylinder quiet zone**
- **The Agilent PNA Orbit/FR Spectrum based data collection system allows both Phase and Amplitude (Linear & CP) Pattern Measurements with data export to Microsoft Excel.**
- **Maintain feeds and standard gain horns for UHF, L-Band, S-band, C-band, X-band, Ku-Band, and Ka-Band.**
- **Chamber Shielded 90 dB to 40 GHz**



Space-rated Thermal Vacuum Chamber

4 ft x 6 ft horizontal chamber

Space Qualification Testing

1 X 10⁻⁶ Torr

Balloon and aircraft testing

0.25 to 760 torr

Vacuum System:

Oil-free mechanical pump and
cryogenic pump

Thermal Simulation:

Twelve independently controlled
stainless steel panels

Contamination Monitoring:

TQCM, cold finger, scavenger plate

Instrumentation:

Type-T TCs and a Fluke 2686A DAQ
with PAI modules

Usable shroud envelope:

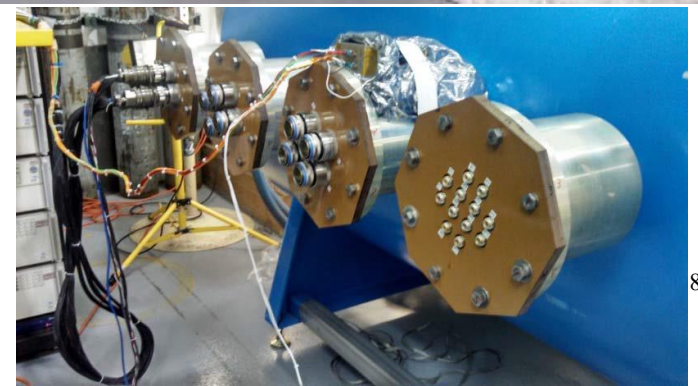
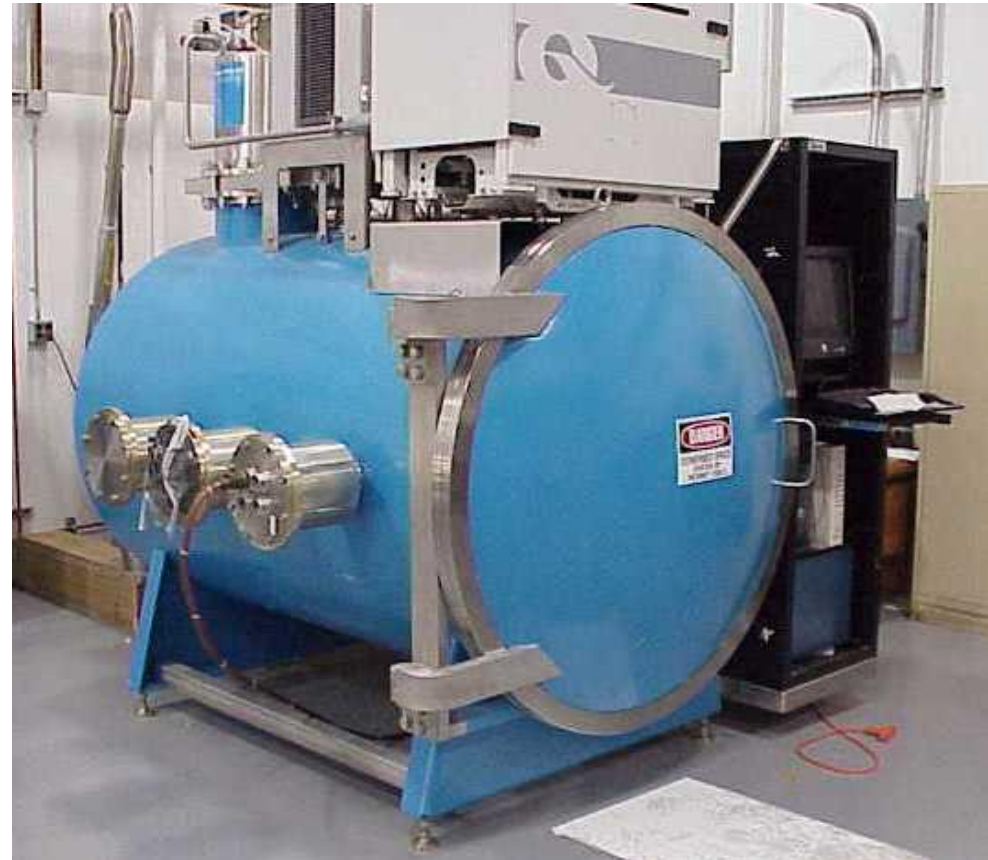
4' diameter

5' 11" length

Full opening door, bracket hinged.

Six instrumentation/power feedthrough

Ports.



Bldg F-7 High Bay East

- ***Class 100,000 cleanroom with an ESD floor.***
- ***40 ft. x 60 ft. cleanroom with 20 ft. x 40 ft. Airlock/Ante Room***
- ***5-Ton Bridge Crane; 25 ft. hook height; Remote Controls***





Bldg F7 High Bay West



9/20/12



Bldg F7 Fabrication Facility



9/20/12

WFF AETD Labs in Engineering Building E-109



Mission Planning Lab



Fabrication Area



I&T Labs



Electrical Labs



GPS Simulator Lab

Capabilities

Usable Envelope	70" wide x 21" deep x 46" tall interior Stainless Steel tabletop
Flow	HEPA filter 99.99% efficient Velocity of approximately 90 FPM Designed to provide an ISO Class 5 (Class 100) or ISO Class 4 (Class 10) clean air environment
Electrical	Motor speed is variable with Solid State controller Electrical outlet is a 15 amp duplex installed in the base right front under the table System provides independent motor and light on/off switches
Motor/Blower	System utilizes a PSC direct drive motor with a dynamically balanced blower wheel Assembly is double vibration isolated from cabinet to provide excellent vibration control



Capabilities

Fixture	10" X 10" high strength magnesium alloy mounting fixture
Shaker	Sine and Random Rating: 2200lbs Maximum Shock: 4500lbs Frequency Range: 5Hz-2kHz
Accelerometers	Various sizes Single axis Tri-axis
Software	Unholtz-Dickie Corporation
Performance	Sine/Random/Shock

Applications:

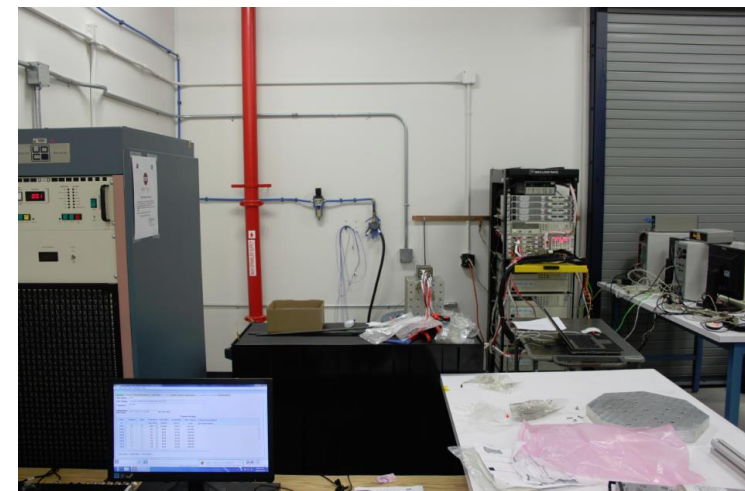
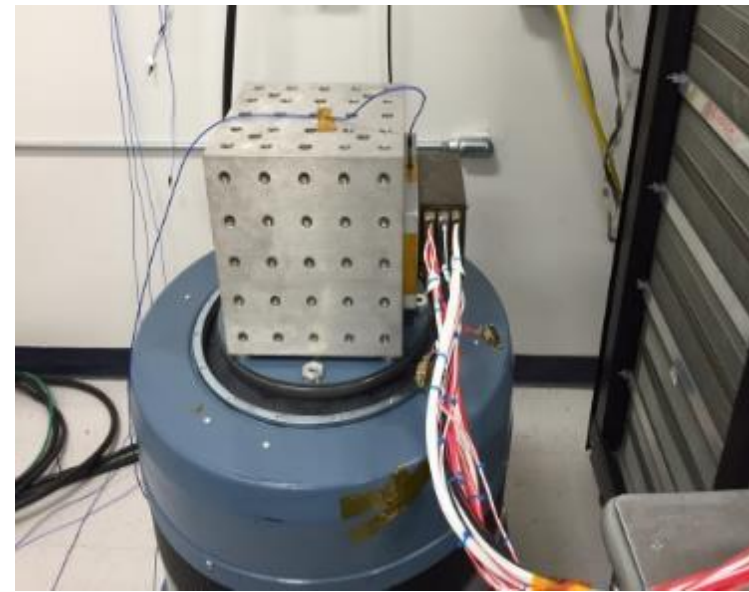
- Space qualification testing
- Environmental testing for electronic flight hardware

Contact POC:

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- ***4 Spirent simulators capable of up to 4 RF outputs of GPS L1/L2/L5***
- ***Able to model a range of antenna patterns***
- ***Simulation capability able to simulation a range of trajectories along with simulated IMU output for HWIL and SWIL testing***



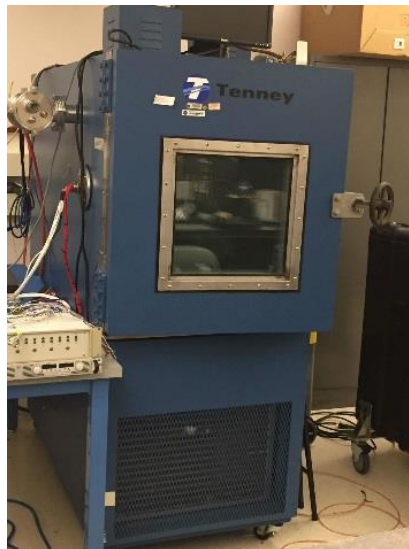
Autonomous scenario run capability for Monte Carlo, parametric run testing for large number of HWIL/SWIL tests

E109 Solar Simulator

- **3 kW Fresnel Lens, Xenon Lamp Solar Simulator**
- **Class ABA***
- **11" Beam diameter**
- **~1350 W/m² max output**
- **Two-axis gimbal and linear actuators available**

E109 TVac Chamber

- **Pressure as low as 0.1 Torr**
- **Temperature: -70°c to +170°c**
- **Dimensions: 21"D"x24"H"x21"W"**



E109 TVac

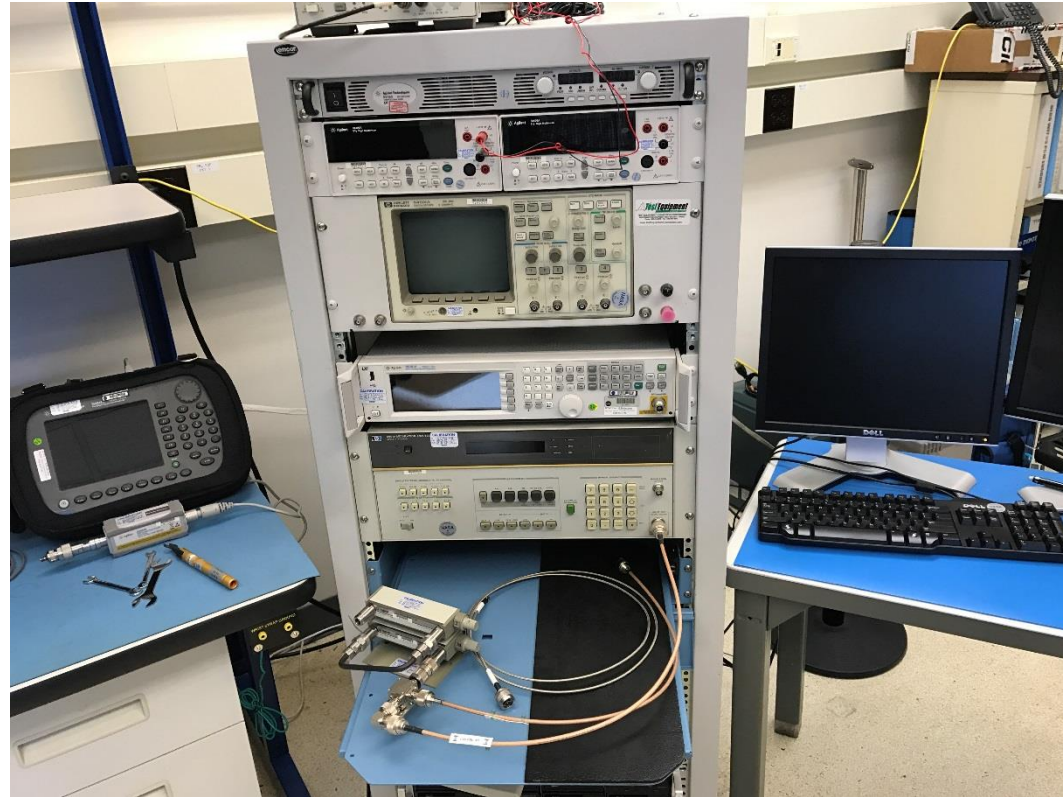


E109 Solar Simulator

* Beam uniformity specification is suspect

Bldg E109 Radar Lab Facility

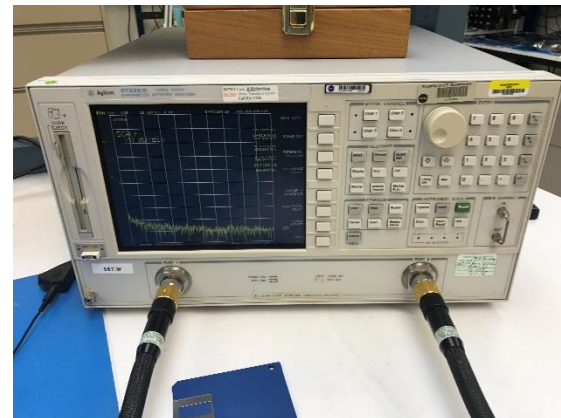
- Radar Transponder Certification Bench.
- Flight Termination Receiver System (FTS) Certification Bench
- Test Equity Model 115 Thermal Cycle Chamber

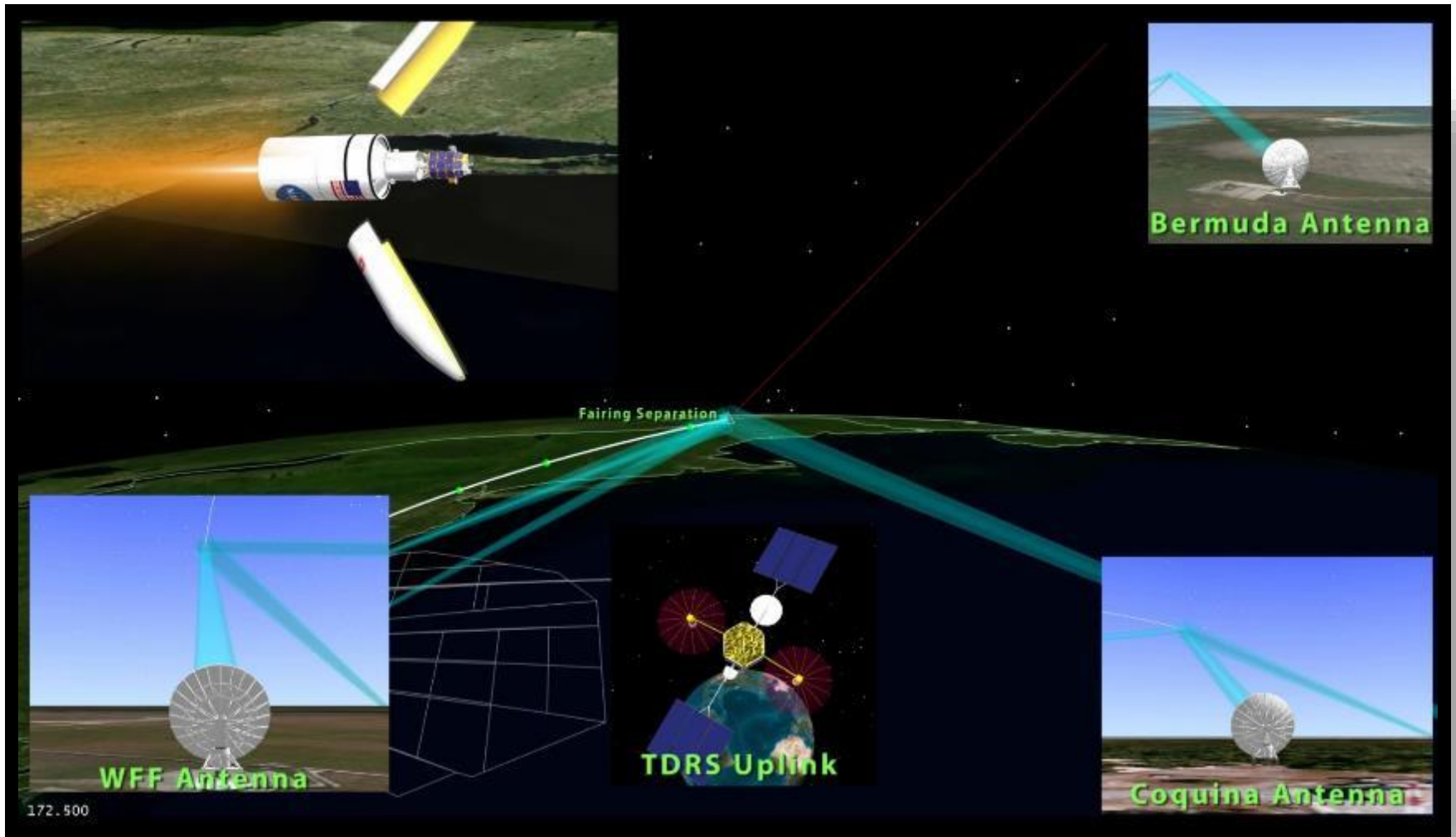


Flight Termination Receiver System
(FTS) Certification bench

Bldg E109 Microwave Lab Facility

- **Cortex XXL™
Telemetry Receiver
System**
- **Agilent/Keysight
Microwave Network and
Spectrum Analyzers**
- **Microwave Telemetry
LCT2 Transceiver
Software Designed
Radio Development and
Test Area**
- **Field Programmable
Gate Array (FPGA)
Design and Test Area**



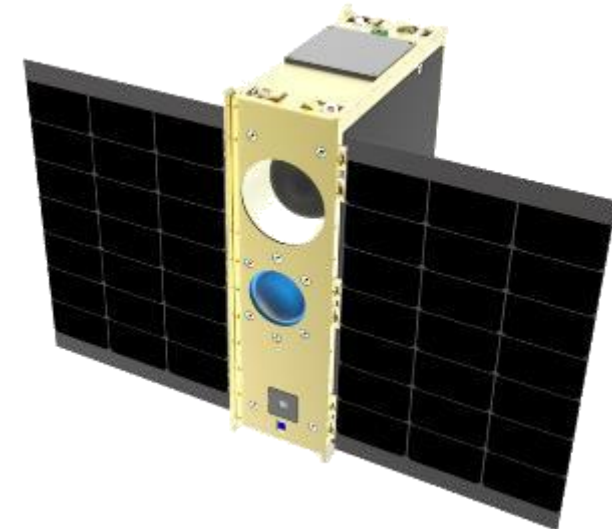
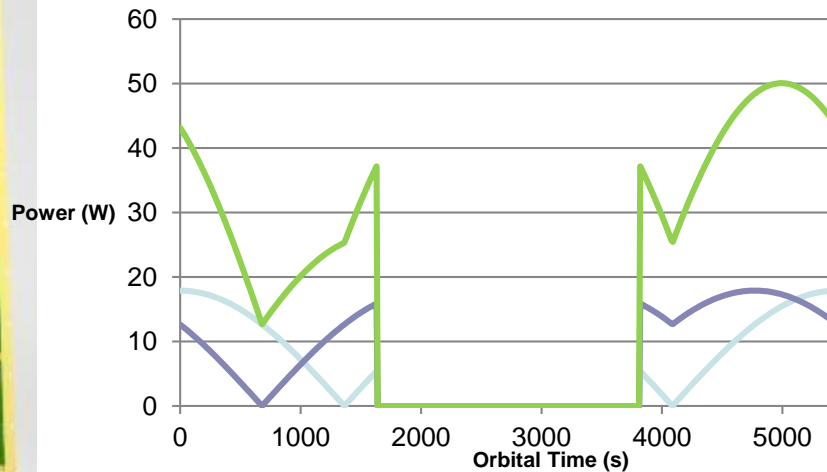
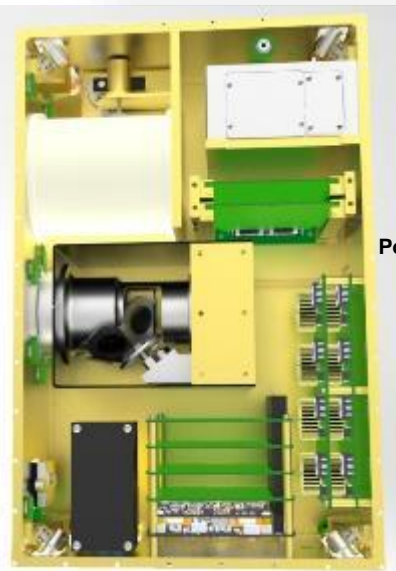


E-109 Mission Planning Lab (MPL) – SmallSat/CubeSat Design



IceCube

Subsystem	Component	Power (W)	Cycle Length (hours)	Science Mode (Deploy)		Science Mode (Deploy) + Tx		Detumble Mode	
				Duty Cycle	W/hrs Used/Cycle	Duty Cycle	W/hrs Used/Cycle	Duty Cycle	W/hrs Used/Orbit
Experiment	CMOS	0.6	1.5	0.22200	0.200	0.22200	0.200	0.000	0.000
	Interface Board	1	1.5	0.22200	0.333	0.22200	0.333	0.000	0.000
	Filter Motor	5	1.5	0.00556	0.042	0.00556	0.042	0.000	0.000
Blue Canyon XACT	Blue Canyon XACT	1.2	1.5	1.00000	1.800	1.00000	1.800	1.000	1.800
	Fine Sun Sensor	1	1.5	1.00000	1.500	1.00000	1.500	1.000	1.500
	Thrusters	0.3	1.5	1.00000	0.450	1.00000	0.450	1.000	0.450
	Photo Diodes	0.5	1.5	1.00000	0.750	1.00000	0.750	1.000	0.750
Comm	Tx	6.4	1.5	0.00000	0.000	2.67000	25.632	0.000	0.000
	Rx	6.4	1.5	1.00000	9.600	1.00000	9.600	1.000	9.600
	Antenna	0.0264	1.5	1.00000	0.040	1.00000	0.040	1.000	0.040
C&DH	CHREC	2.58	1.5	1.00000	3.870	1.00000	3.870	1.000	3.870
Power	EPS	0.1	1.5	1.00000	0.150	1.00000	0.150	1.000	0.150
	Custom Card	1	1.5	1.00000	1.500	1.00000	1.500	1.000	1.500
Batteries	Consumption	0.3	1.5	1.00000	0.450	1.00000	0.450	1.000	0.450
	Heaters	0.594	1.5	0.10000	0.089	0.10000	0.089	0.100	0.089
Total Consumed		27.0004			20.773		46.405		20.199
Consumption EPS Losses =		10.0%			2.077		4.641		2.020
Consumption Harness Losses =		5%			1.039		2.320		1.010
Consumption Battery Losses =		5%			1.039		2.320		1.010
Total Consumed (Inc EPS, Harness and Battery Losses)					24.928		55.686		24.238
Worst Case Energy Production (Beta = 0, Orbit Average X Orbit Length)					56.3		56.3		0
Charging EPS Losses =				15.0%	8.445		8.445		0.000
Charging Battery Losses =				5.0%	2.815		2.815		0.000
Worst Case Energy Production (Including EPS and Battery Losses)					45.040		45.040		0.000
Net W/hrs Per Cycle (Production - Consumption)					20.112		-10.646		-24.238
# orbits on a typical day (Orbit length = 90 minutes)					15.00		1		
Net W/hrs on a day (Net W/hrs per Orbit * #Orbits)					301.682		-10.646		



Bldg F10 Sounding Rockets Facilities

Bldg F10 Vibration Testing

- There are four Ling Electronics shakers used for component and payload vibration tests at WFF with the following technical information.
- **NSROC Shaker Specifications**
- **Ling Electronics Shaker B340**
 - Rated Force Sine: 30,000 lb
 - Rated Force Random: 30,000 lb rms
 - Frequency Range: 5-2000 Hz
 - Maximum Displacement Peak-Peak: 1 inch
 - The B340 can be rotated to mate with a TEAM Corp. model 482 sliding table so that it can be used for both thrust axis and lateral vibration tests. Max. pitch moment capacity = 1,200,000 lb.-in.
- **Ling Electronics Shaker B335 (x2)**
 - Rated Force Sine: 18,000 lb
 - Rated Force Random: 18,000 lb rms



Ling Electronics B335 Thrust Axis
Shaker at WFF



Bldg F10 Vibration Testing(cont)

- **Ling Electronics Shaker B335 (x2, continued)**
 - Frequency Range: 5-3000 Hz
 - Maximum Displacement Peak-Peak: 1 inch
- The B335 can be rotated to mate with a TEAM Corp. model 482 sliding table so that it can be used for both thrust axis and lateral vibration tests. Max. pitch moment capacity = 240,000 lb.-in.
- **Ling Electronics Shaker B395**
 - Rated Force Sine: 6000 lb
 - Rated Force Random: 5,750 lb rms
 - Frequency Range: 5-3000 Hz
 - Maximum Displacement Peak-Peak: 1 inch
- The WFF Shaker test facilities are equipped with 11 in. cube fixtures so that tests can be performed on small components in all three axes by mounting the test article in different orientations. At the engineer's or Principal Investigator's request, sensors can be mounted on any part of the payload to monitor its response. WFF Shaker test facilities have 16-channel capability

Bldg F10 Static and Dynamic Balancing Machines

- At WFF, a Gisholt Rocket Balancing Machine is used to balance sounding rocket payloads (Figure 6.2.2-1)
- This machine's specifications are listed below.
 - Max. payload weight = 1500 lb.
 - Max. height of CG above table = 10 ft.
 - Measurement accuracy = 2.0 oz-in² at 225 rpm or more



Bldg F10 Airdyne Mark 8 Mass Properties Measurement System



- The Environmental Testing and Evaluation Group at WFF is equipped with an Airdyne Mark 8 mass properties measurement system. This unit is used for measuring center of gravity (CG) locations and moments of inertia (MOI) on sounding rocket subsystems and payload stacks. Important technical data include:
 - Maximum test article weight: 5,000 lb.
 - Maximum CG height above the table: 120 in.
 - CG and MOI measurement accuracy: 0.1%



Bldg F10 Attitude Control Systems Testing Facility



Attitude Control System Test Lab

Bldg F10 Spin Deployment Facility

6.2.6 Spin Deployment and Separation Equipment (WFF)

Payloads with deployable booms, nose cones, doors, etc. can be tested for proper operation using the spin deployment and separation chamber at WFF. The rotary table is capable of spinning a payload to a rate of 20 rps while withstanding an imbalance of up to 3000 ft-lb. 5 ft. above the table surface. The chamber is equipped with a heavy-duty Kevlar® tarp around the rotary table for catching deployed components. Also, there are video cameras mounted on the chamber walls for recording and timing the deployment events. Pyrotechnic release devices can be activated by connecting lead wires through a 20-channel slip ring that allows the table to rotate while maintaining electrical continuity.



Spin Deployment Facility

Bldg F10 Bend Test Facility

6.2.5 Bend Test Fixtures (WFF and WSMR)

Every sounding rocket payload is subjected to a bend test in order to determine the overall stiffness of the body. This information is used by the Flight Performance Group to verify payload stability during flight. The bend test fixtures at WFF and WSMR consist of a base plate mounted to the concrete floor and a pneumatic (WFF) or motor driven (WSMR) linear actuator mounted to a steel I-beam pillar. The pistons are equipped with load cells, which are used to measure and control the applied load. The aft end of the payload is fastened to a base plate, and the actuator's position along the pillar can be adjusted to the proper height on the payload being tested. Land surveying equipment is used to accurately measure the tip deflection of the payload as the actuator applies lateral loads in both directions.



Figure 6.2.5-1: Bend Test Fixture at WFF

Table 6.2.5-1 NSROC Bend Test Fixture Specifications

Facility	Maximum Load (actuator or load cell)	Maximum Actuator Height	Accuracy of Deflection Readings
WFF	+/- 5,000 pounds	21 feet	0.05 inches
WSMR	+/- 1,150 pounds.	21 feet	0.05 inches

Bldg F10 Centrifuge Test Facility



6.2.7 Centrifuge Machine (WFF)

A Genisco Model 1068-2 centrifuge machine is used for component acceleration tests at WFF. It is capable of achieving up to 1000 g acceleration at a radius of 10.5 in. It has 8" of clearance between the 3' diameter rotary table and the cover.



Figure 6.2.7-1 Genisco Centrifuge Machine at WFF

Bldg F10 Thermal Vac



Figure 6.2.4-1 PV/T Vacuum Chamber (left) and Tenney Space Simulation System Thermal Vacuum Chamber at WFF

Table 6.2.4-1: NSROC Vacuum and Thermal Vacuum Chamber Specifications

Manufacturer	PV/T Inc.	Tenney Space Simulation System	Tenney Space Jr.
Inside Dimensions (ft. dia. x ft. lg.)	7x12	2x2	1.2x1.0
Minimum Pressure (torr)	2×10^{-5}	3×10^{-8}	7.5×10^{-8}
Temperature Range (°C)	N/A Heat lamps used if needed	-73 to +125	N/A

WFF Magnetic Test Facility

6.2.8 Magnetic Test Facility (WFF & WSMR)

At WFF, this facility is used to conduct magnetic calibration of magnetometers on sounding rocket payloads and to perform functional tests on magnetic attitude control systems. When required, magnetic calibration tests are done - generally for all payloads with magnetometers except those in which the magnetometers are used as roll or yaw indicators. The testing equipment consists of a three axis, 40 ft. square Braunbek system which is capable of canceling the effects of the earth's magnetic field and then generating a test field in any direction. Technical data are listed below.



Figure 6.2.8-1 The Magnetic Test Facility at Wallops

WFF Magnetic Test Facility(cont)

- Resolution = 10 nanotesla
- Field magnitude = 0 to 65,000 gamma.

Table 6.2.8-1: Instrumentation Available at the WFF Magnetic Test Facility

<u>Item</u>	<u>Function</u>	<u>Specifications</u>	<u>Model</u>
Proton Magnetometer	Calibration	Range: 20K-120K Gamma Resolution: 0.01 Gamma System Accuracy: 0.2 Gamma GSM-19	GEM
Triaxial Fluxgate Magnetometer	Test Instrumentation	Range: ± 100 K Gamma Resolution: 3 Gamma Orthogonality: 25 Arcmin	EMDS SDM-313
Triaxial Fluxgate Magnetometer	Ambient Sensor (outside)	Range: ± 100 K Gamma Resolution: 3 Gamma Orthogonality: 25 Arcmin	EMDS SDM-313
Payload Magnetometer	Test Instrumentation	Range: ± 100 K Gamma Resolution: 3 Gamma Orthogonality: 1 Degree	Bartington Mag-03MRN
Theodolites	Alignment	Resolution: 20 Arcsec Dicarlo	Theo020B
RF Horn Antenna	Data Receiving Freq.	Range: 1-18 GHz Gain: 7 dB Model 3115	Emco
RF to Fiber-Optic Transmitter	Data Conversion Freq.	Range: .1-5 GHz Watts: 6.4 mW 3450A-20	Ortel

WFF Magnetic Test Facility(cont)



Table 6.2.8-2: Magnetic Test Facility Specifications

Physical Dimensions:	
Access Opening	8'8" H x 7'5" W
Static Field Environment:	
Magnitude (each axis)	$\pm 100\text{K}$ Gamma
Step Resolution	± 3.7 Gamma
Stability	± 10 Gamma/minute for first 30 minutes ± 3 Gamma/minute after 60 minutes
Homogeneity	0.02%, 6 ft. spherical diameter
Dynamic Field Environment:	
Magnitude	$\pm 60\text{K}$ Gamma
Frequency	10 Hz, Although 10 Hz to 100 Hz @ 1K Gamma has been performed
Turntable	4' Diameter
Coil Orthogonality	1.8 Arcmin, Calibrated on 9/27/96
Fields	Earth, 0-15 Volts DC, 0-25 Amps Test, (3-Axis) 50 Volts AC, ± 8 Amps Gradient, 15 Volts DC, 6 Amps

Bldg F10 Payload Fabrication





Bldg F10 Payload Fabrication

- Wallops has a fully equipped machine shop that can provide electronic, electrical and mechanical support. The 26,000-square-foot machine shop includes a large selection of Computer Numerically Controlled (CNC) mills and lathes, manual machines, sheet metal fabrication, welding and heat-treating facilities. Capabilities include full CAD/CAM implementation in developing and fabricating mechanical systems, optical instrumentation, and payload components for flight research. The fabrication area performs functions such as sounding rocket launcher refurbishment, design and fabrication of mobile telemetry and mobile radar support vans and antenna systems. The machine shop includes mechanical technician laboratories for assembly of scientific sounding rocket payloads. While the facility primarily supports the Sounding Rocket Program, it regularly supports other NASA and reimbursable projects. The facilities are managed through the NASA Sounding Rocket Operations Contract (NSROC).

Bldg F10 Payload Integration & Testing



- Bldg F10 has four Independent Payload Integration and Testing (I&T) Areas
- Each I&T Area has its own Independent Telemetry Ground Station



Bldg F10 Telemetry Ground Station (1 of 4)



Frequencies:

Modulation Formats:

of Channels:

Wallops Island Environmental, Integration, & Testing Capabilities



Wallops Island Assembly and Payload Processing Facilities



Table 3-1. Assembly and Payload Processing Facilities Wallops Island

Building	Function	Sq.Ft.	Special Features																											
V-45	Assembly	4,933	<ul style="list-style-type: none"> • 10-ton bridge crane – critical 																											
V-55	Assembly	2495	<ul style="list-style-type: none"> • 20-ton bridge crane – critical 																											
W-15	Assembly	5,165	<ul style="list-style-type: none"> • one 3,936 sq. ft. bay • door 13 ft high x 12 ft wide • 3-ton overhead crane with 10-ft hook height • approved for explosives • 6-ton bridge crane – non-critical 																											
W-40	Assembly	5,255	<ul style="list-style-type: none"> • 6-ton bridge crane (dual 3-ton trolleys) – non-critical 																											
W-65	Assembly	13,255	<ul style="list-style-type: none"> • 6 bays • 6 assembly bays • pyrotechnic storage rooms • approved for explosives <table border="1"> <thead> <tr> <th>Bay Doors</th> <th>HxW</th> <th>Crane(s) hook height (hh)</th> </tr> </thead> <tbody> <tr> <td>Bay 1</td> <td>7 ft 10 in x 23 ft 11 in</td> <td>2x10 ton bridge/20 ft hh</td> </tr> <tr> <td>Bay 2</td> <td>18 ft x 23 ft 11 in</td> <td>2x7.5 ton monorail/18 ft hh</td> </tr> <tr> <td></td> <td>17 ft 10 in x 23 ft 11 in</td> <td></td> </tr> <tr> <td>Bay 3</td> <td>17 ft 10 in x 18 ft 11 in</td> <td>2x3 ton monorail/19 ft hh</td> </tr> <tr> <td>Bay 4</td> <td>14 ft 11 in x 15 ft 11 in</td> <td></td> </tr> <tr> <td>Bay 5</td> <td>14 ft 11 in x 15 ft 1 in</td> <td>2x3 ton monorail/16 ft 5 in hh</td> </tr> <tr> <td>Bay 6</td> <td>14 ft 11 in x 23 ft 11 in</td> <td>2x3 ton monorail/16 ft hh</td> </tr> <tr> <td></td> <td>14 ft 11 in x 23 ft 11 in</td> <td></td> </tr> </tbody> </table>	Bay Doors	HxW	Crane(s) hook height (hh)	Bay 1	7 ft 10 in x 23 ft 11 in	2x10 ton bridge/20 ft hh	Bay 2	18 ft x 23 ft 11 in	2x7.5 ton monorail/18 ft hh		17 ft 10 in x 23 ft 11 in		Bay 3	17 ft 10 in x 18 ft 11 in	2x3 ton monorail/19 ft hh	Bay 4	14 ft 11 in x 15 ft 11 in		Bay 5	14 ft 11 in x 15 ft 1 in	2x3 ton monorail/16 ft 5 in hh	Bay 6	14 ft 11 in x 23 ft 11 in	2x3 ton monorail/16 ft hh		14 ft 11 in x 23 ft 11 in	
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	14 ft 11 in x 23 ft 11 in																													

Wallops Island Assembly and Payload Processing Facilities (cont)



Building	Function	Sq.Ft.	Special Features																											
X-15	Payload processing	5,740	<ul style="list-style-type: none"> • co-located optical and crash/fire/rescue facilities • door 19 ft 10 in high and 18 ft 10 in wide • 3-ton overhead crane with 19-ft hook height • laboratory and office space • 1-ton stationary electric chain hoist – non-critical • 1-ton electric chain hoist – non-critical • 5-ton bridge crane – non-critical 																											
Y-15	Assembly	8,240	<ul style="list-style-type: none"> • one high bay (Bay 8) • seven other bays • approved for explosives <table border="0"> <thead> <tr> <th>Bay Doors</th> <th>HxW</th> <th>Crane(s) hook height (hh)</th> </tr> </thead> <tbody> <tr> <td>Bay 1</td> <td>9 ft 6 in x 17 ft 6 in</td> <td></td> </tr> <tr> <td>Bay 2</td> <td>6 ft 10 in x 8 ft</td> <td></td> </tr> <tr> <td>Bay 3</td> <td>6 ft 10 in x 8 ft</td> <td></td> </tr> <tr> <td>Bay 4</td> <td>6 ft 10 in x 8 ft</td> <td>3-ton monorail/7 ft 10 in hh</td> </tr> <tr> <td>Bay 5</td> <td>6 ft 10 in x 8 ft</td> <td></td> </tr> <tr> <td>Bay 6</td> <td>6 ft 10 in x 8 ft</td> <td>3-ton monorail/7 ft 10 in hh</td> </tr> <tr> <td>Bay 7</td> <td>6 ft 10 in x 8 ft</td> <td></td> </tr> <tr> <td>Bay 8</td> <td>13 ft 7 in x 10 ft 10 in</td> <td>2-ton bridge/15 ft 10 in hh</td> </tr> </tbody> </table>	Bay Doors	HxW	Crane(s) hook height (hh)	Bay 1	9 ft 6 in x 17 ft 6 in		Bay 2	6 ft 10 in x 8 ft		Bay 3	6 ft 10 in x 8 ft		Bay 4	6 ft 10 in x 8 ft	3-ton monorail/7 ft 10 in hh	Bay 5	6 ft 10 in x 8 ft		Bay 6	6 ft 10 in x 8 ft	3-ton monorail/7 ft 10 in hh	Bay 7	6 ft 10 in x 8 ft		Bay 8	13 ft 7 in x 10 ft 10 in	2-ton bridge/15 ft 10 in hh
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Wallops Fabrication, Integration, & Testing Capabilities



Figure 3-10. H-100 Payload Processing Facility (PPF)



Figure 3-11. V-55 Spacecraft Fueling Facility (SFF)