ENVIRONMENTAL TESTING AT NASA'S GODDARD SPACE FLIGHT CENTER

NASA Goddard Small Satellite Project Office

ENVIRONMENTAL TESTING AT NASA GODDARD

Goddard's Environmental Test, Engineering and Integration Branch (Code 549) provides the following environmental test support in one building complex:

- Structural Dynamics
- EMC & Magnetics
- Space Simulation
- Mechanical Integration
- Electrical Cable Harness
- Contamination Control & Logistics
- LDE (Lifting Devices & Equipment)
- PVS (Pressure Vessels & Systems)
- Purge
- Facility Engineering
- Information Systems
- Functional Support
- System Support

ENVIRONMENTAL TESTING AT NASA GODDARD

Code 549 provides Engineering, Technical Expertise on & off-site:

- **Environmental Testing:** Structural Dynamics, EMC & Magnetics, Space Simulation
- **Mechanical Integration:** Cradle to grave support of flight & ground equipment, design, fabrication & integration. Manual & CNC (computer numerical control) fabrication of rapid need machining tasks.
- **Optical Integration:** Alignment, Integration & Test, Optical Cryogenic Testing, Fabrication, Procurement
- **Electrical Cable Harness:** Design, Fabricate, Installation, Hi-Pot
- **Thermal Blankets:** Design, Template, Fab, Installation, etc.
- **Facility Maintenance:** Electrical power upgrades/modification, HVAC modifications, special project needs
- **Contamination Control & Logistics:** Certify cleanrooms, clean tents, labs, flow benches, provide ISO 7 CC & ESD garments, hardware cleaning, project requested CC engineering & tech CC support on & off site
- **LDE:** Test, inspect, certify lifting devices & equipment including cranes, manlifts, forklifts & rigging.
- **PVS:** Inspect, certify pressure vessels & systems including vessels, piping, components
- **Purge:** Design, build, test, operate flight purge systems & pressure systems
- **Facility Engineering:** Facility modifications, proof testing, design & fabricate MGSE, slings, test fixtures
- **Information Systems:** One stop shop for all IT services in B7 complex, network drops, firewall access, setting up special switches for data acquisition, CNE support, etc.
- **Functional Support:** Safety, Quality Assurance, Calibration, Commercialization
- **Engineering Support**: Provide contract vehicle to companies for project customer support

STRUCTURAL DYNAMICS- VIBRATION & SHOCK

The vibration test facility provides all necessary services and equipment to perform shock and vibration testing of spacecraft and subsystems. Digital control systems provide sinusoidal, random, and transient waveform control to four separate electrodynamic exciters. The control systems are capable of response limiting based on either acceleration or force signals. Digital data acquisition systems condition, record, and analyze up to 256 channels of accelerometer, force, and strain gage signals.

AVAILABLE EXCITERS:

UD T4000 Shaker/2XSAI180 AMPLIFIER

- 40000 lb rms random force and 40000 lb peak sine force
- 1.7 inch displacement double amplitude
- 50"x50" slip table
- Serviced by 7.5 ton micro travel mode bridge crane

UD T4000 Shaker/2XSAI180 Amplifier

- 40000 lb rms random force and 40000 lb peak sine force
- 2.7 inch displacement double amplitude
- 74"x76" slip table
- Serviced by 7.5 ton micro travel mode bridge crane

UD T2000 Shaker/SAI120 Amplifier

- 18000 lb rms random force and 16000 lb peak sine force
- 2.7 inch displacement double amplitude
- 24"x24" slip table
- Serviced by 2 ton monorail crane

UD T2000 Shaker/SAI120 Amplifier

- 18000 lb rms random force and 16000 lb peak sine force
- 2.7 inch displacement double amplitude
- Serviced by 2 ton monorail crane

STRUCTURAL DYNAMICS- ACOUSTIC TESTING

Acoustic Test Facility consists of a 10m x 8.2m x 12.8m reverberation chamber with 2 horns and a closed loop control system. Acoustic energy is generated by modulating the flow of GN2 through the generators attached to the horns. The closed loop control system adjusts the sound pressure level within the chamber to the required spectrum based on the signals from up to 8 microphones. Digital data acquisition systems condition, record, and analyze up to 256 channels of accelerometer, microphone, and strain gage signals. The facility can be operated as a Class 100000 clean room when necessary.

Parameters:
Generators (2): 40kW, electro-pneumatic WAS3000
Horns (2): 25Hz exponential, 50Hz hypex
Maximum SPL: 150dB
Frequency Range: 25Hz to 10kHz

STRUCTURAL DYNAMICS-
MASS PROPERTIES MEASUREMENT FACILITY

The Mass Properties Measurement Facility (MPMF) is used to measure the weight, center of gravity (CG), moment of inertia (MOI), and product of inertia (POI) of large aerospace structures. The facility can also be used to balance payloads statically and dynamically.

Parameters:

4ft diameter mounting table, 10ft table is available for large payloads

10000 lb. weight capability

30000 in-lb. moment capability

Table rotational speed of 0-200 rpm

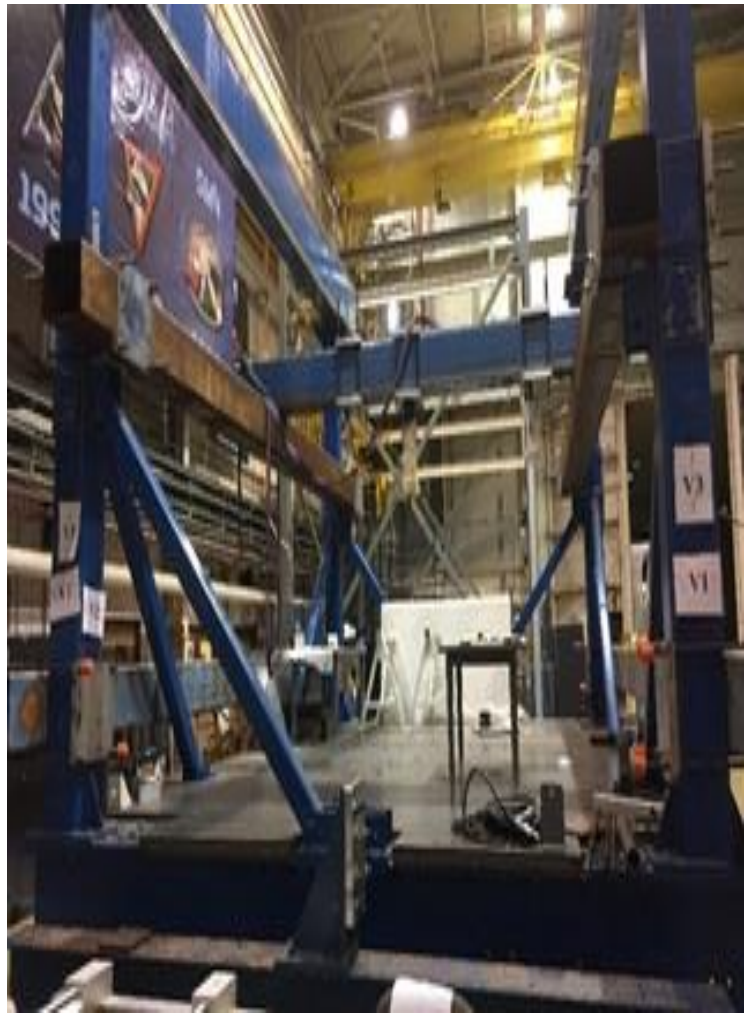
STRUCTURAL DYNAMICS- HIGH CAPACITY CENTRIFUGE (HCC)

The High Capacity Centrifuge (HCC) is a 120 ft. diameter arm capable of accelerating a 5000 lb. payload to 30 G's (38 rpm) to simulate launch and landing loads. The HCC is driven by two 0.93 Mw (1259 hp) DC motors operated in conjunction with a motor generator set. Using the facility's 7.5 ton monorail crane, test items are mounted on a special low profile tilt fixture on the arm's test platform. The low profile tilt fixture simplifies the handling operations necessary to properly orient the payload to the desired load vector. The facility is serviced by a Vishay data acquisition system.

Onboard the centrifuge arm, the mainframe unit provides signal conditioning and data acquisition. In the HCC control room, a Windows PC provides test setup, instrumentation test control, data display, and data storage. The data system is capable of various combinations of 120 channels of strain, deflection, and acceleration measurements. Also digital video of the test platform is available for viewing and recording during the test.

STRUCTURAL DYNAMICS-
STATIC TEST FACILITY (BLUE FACILITY) & LOAD TESTING MACHINE

- The static test facility is comprised of the universal static test facility, the small static test facility, and the universal load testing machines. These facilities are used to perform strength tests on aerospace structures and their components.
- **Universal Static Test Facility**
  This facility is a structural steel framework designed for the application of static loads to spacecraft and shuttle payload bay carrier sized items. Test items are mounted in the facility using a 7.5 ton overhead bridge crane. Pre-drilled reaction beams facilitate set up and operation. Hydraulic actuators and associated load monitoring devices and load links are installed between the structure and the test item. The applied loads are controlled by manually operated hand pumps. The facility is serviced by a 120 channel data acquisition system that is capable of conditioning and recording strain gage, load cell, and displacement transducer signals.
- **MTS Landmark Universal Load Testing Machine**
  The MTS Landmark universal load testing machine is used for tensile, compressive, and cyclic fatigue testing. The Landmark machine has a 100,000 lb. capacity.



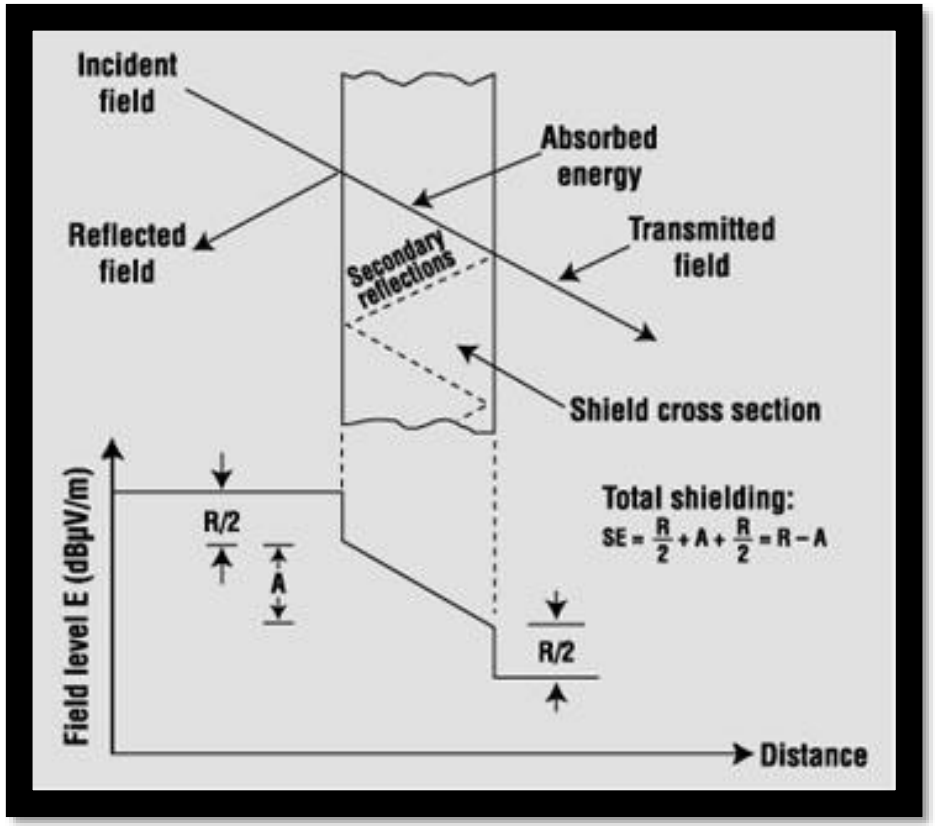
EMI/EMC
(ELECTROMAGNETIC INTERFERENCE/ELECTROMAGNETIC COMPATIBILITY)

The Code 549 EMI test group has the facilities and technical expertise to perform EMI/EMC and magnetic testing. Below are the primary standards we support:

- GSFC-STD-7000 (Rev. A)
- MIL-STD-461 C/F/G

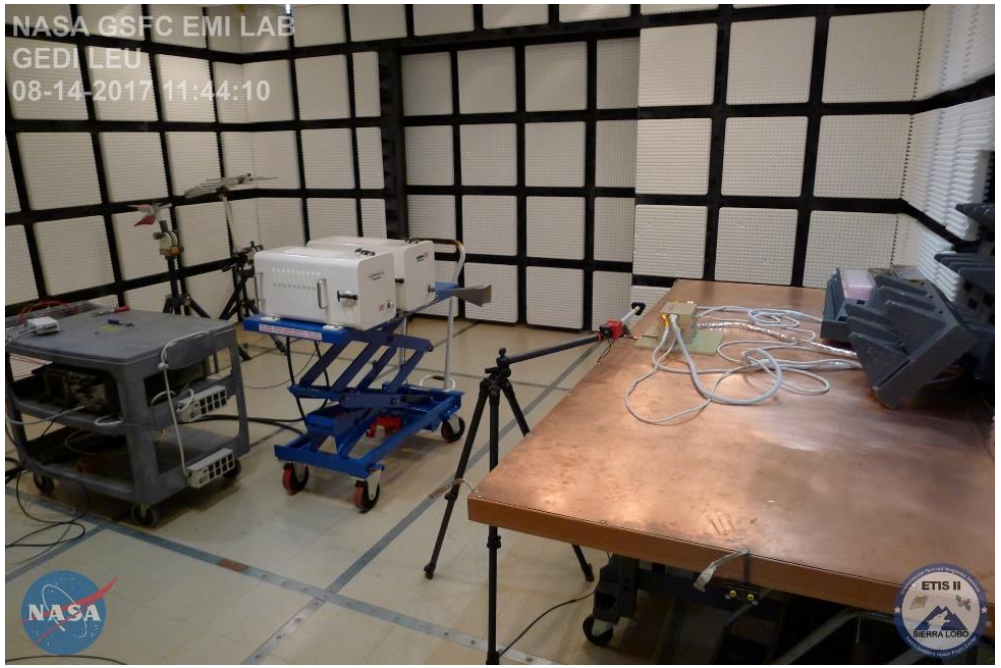
All EMI facilities meet MIL-STD-285 and IEEE-299 shielding effectiveness.

All test chambers are lines with ferrite tiles and RF absorbers to ensure field uniformity across the entire test article.



Small EMI Chamber

- Primarily used for small test articles
  - Semi-anechoic test enclosure: 5.5m (L) x 5m (W) x 3m (H)
  - EGSE room: 4m (L) x 2m (W) x 3m (H)
  - Test bench: 2.5m (L) with cooper ground plane bonded to facility



Large RFI Chamber

- Primarily used for test articles requiring ISO7 certified cleanliness
  - Semi-anechoic test enclosure: 12m (L) x 10m (W) x 6.7m (H)
  - EGSE room: 6.7m (L) x 5.2m (W) x 3.2m (H)

Testing the James Webb Space Telescope with Radio Waves

The instruments that will fly aboard NASA's James Webb Space Telescope not only have to be tough enough to survive in the cold of space, but they also have to work properly in the electromagnetic environment on the spacecraft, so they're tested for both. Recently, they passed a test for the latter in a very unique room.

A team of engineers in special clean room suits at NASA Goddard. Seen from left to right: Andy Mentges, Nathan Block, Vaughn Nelson, Rob Houle, John McCloskey, Mark Branch, Rick Jones, Greg Jamroz.
Credits: NASA/Chris Gunn

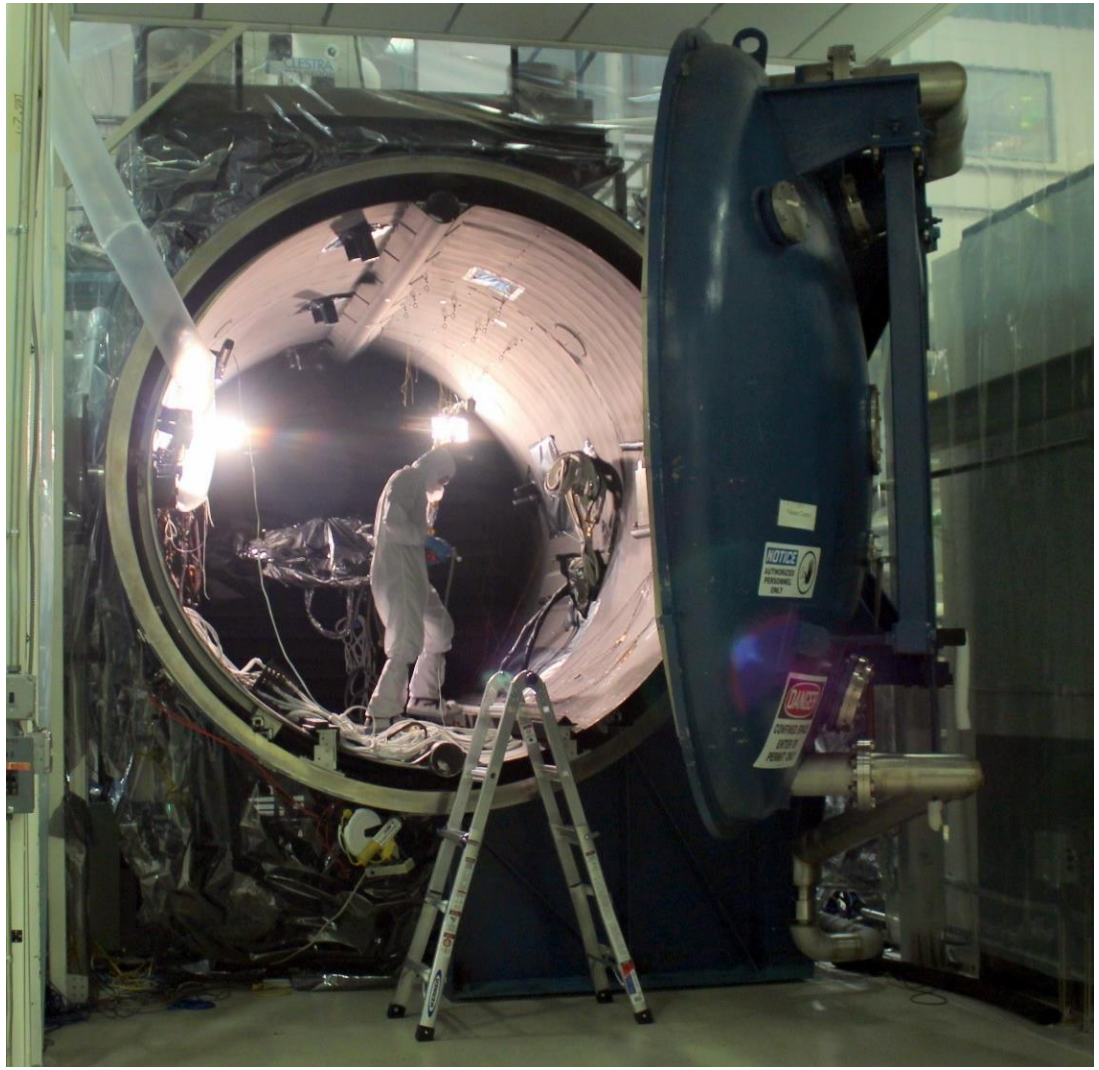
MAGNETIC TEST SITE FACILITY

The Magnetic Test Facility is a 40' Braunbeck Coil that is capable of negating the Earth's magnetic fields in a 6' sphere at it's center. It is the largest of its kind in North America.

Magnetic moment of the spacecraft so that the residual magnetism can be eliminated.

SPACE SIMULATION

Space Simulation provides full service test support engineering expertise, and state of the art facilities to perform simulated space and thermal vacuum cycle testing of earth orbit and deep space flight hardware.



SPACE SIMULATION FACILITIES

- **TV Facility 225** (9′ diameter x 14′) Horizontal
  GN2 mode -140°C to +100°C, LN2 mode -190°C, 2 cryopumps
- **TV Facility 237** (7′ diameter x 8′) Horizontal
  GN2 mode -140°C to +100°C, LN2 mode -190°C, oil diffusion pump
- **TV Facility 238** (12′ diameter x 14′) Vertical
  GN2 mode -120°C to +115°C, LN2 mode -190°C, 4 cryopumps
- **TV Facility 239** (7′ diameter x 8′) Horizontal
  GN2 mode -140°C to +135°C, LN2 mode -190°C, rotary piston cryopump
- **TV Facility 240** (3′ diameter x 3′) Horizontal
  -140°C to +110°C, diffusion pump
- **TV Facility 241** (3′ diameter x 4′) Horizontal
  150°C to +150°C, mechanical pump and cryopumping system, LN2 mode at -190 C
- TV **Facility 245** (2′ diameter x 3′) Horizontal Bakeout Chamber
  +20°C to +150°C, rotary piston mechanical pump & turbomolecular pump

ENVIRONMENTAL TESTING AT NASA GODDARD

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