

# SMALLSAT VERIFICATION & VALIDATION LABORATORY



Proper testing reduces preflight risk and verifies requirements before flight. The Space Dynamics Laboratory's (SDL) small satellite experts use the advanced SmallSat Verification and Validation (V&V) Laboratory to characterize and verify satellite system and subsystem performance. The SmallSat V&V Lab augments SDL's environmental testing and calibration facilities to enable comprehensive small satellite testing.

## FEATURES

- Systems engineering best practices for formal requirements V&V
- Full spacecraft systems testing from 1U to 12U
- Partial testing capabilities for ESPA spacecraft
- High-fidelity testing support for fast-paced, low-cost programs
- Testing facilities co-located with manufacturing, assembly & environmental test facilities

| CAPABILITIES   | FOR TESTING  |
|--|--|
| High-accuracy mass properties testing for measurement of mass, center of gravity (CG) & moments of inertia (MOI)                         | <ul style="list-style-type: none"> <li>• Component mass, CG &amp; MOI</li> <li>• System mass, CG &amp; MOI</li> </ul>  |
| High-accuracy, three-axis magnetic field generation with real-time closed-loop control & zero-gauss chamber for magnetometer calibration | <ul style="list-style-type: none"> <li>• Accuracy &amp; alignment of magnetometers</li> <li>• Torque &amp; polarity for torque rods</li> </ul>   |
| Single-axis air bearing with high-resolution encoder & three-axis air bearing  | <ul style="list-style-type: none"> <li>• Reaction wheel, control-moment gyro, momentum wheel, or similar system characterization &amp; performance</li> </ul>  |
| Solar illumination simulator & NIST-traceable pyranometer  | <ul style="list-style-type: none"> <li>• Solar panel power output verification</li> <li>• System testing using self-generated power (test algorithms, controls, interfaces)</li> </ul>                       |
| Solar array simulator & battery/charger simulator  | <ul style="list-style-type: none"> <li>• System testing using simulated power (test algorithms, controls, interfaces)</li> </ul>   |
| Hardware-in-the-loop (HWIL) system testing   | <ul style="list-style-type: none"> <li>• Test &amp; verification of system interfaces, algorithms &amp; flight software</li> <li>• Component test stations provide for a high-fidelity HWIL model</li> </ul> |
| Star field simulator with Hipparcos star catalog   | <ul style="list-style-type: none"> <li>• Star tracker testing, including static quaternions &amp; simulated slew maneuvers</li> </ul>  |

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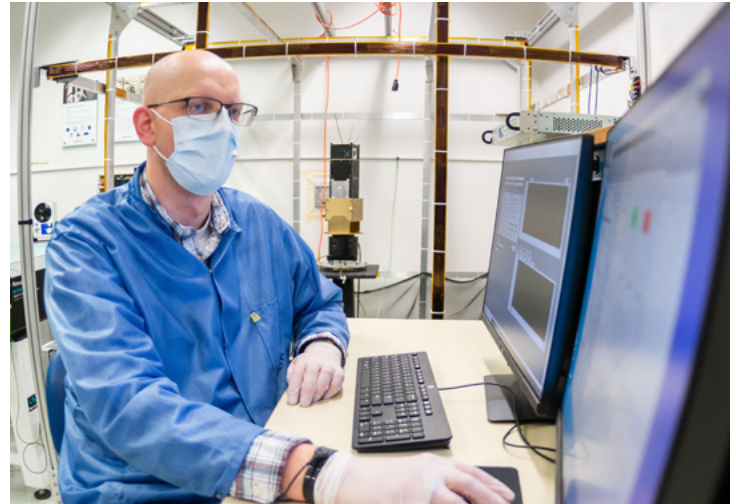
## TEST STATIONS

**The mass properties test stands** offer high-accuracy mass, center of mass, and MOI capabilities for CAD validation, flight acceptance, or static and dynamic balancing of spacecraft. Mass can be measured within 0.5% and the CG to within 2 mm for spacecraft and components from <1 kg to 136 kg. MOI are available for spacecraft up to 113 kg.

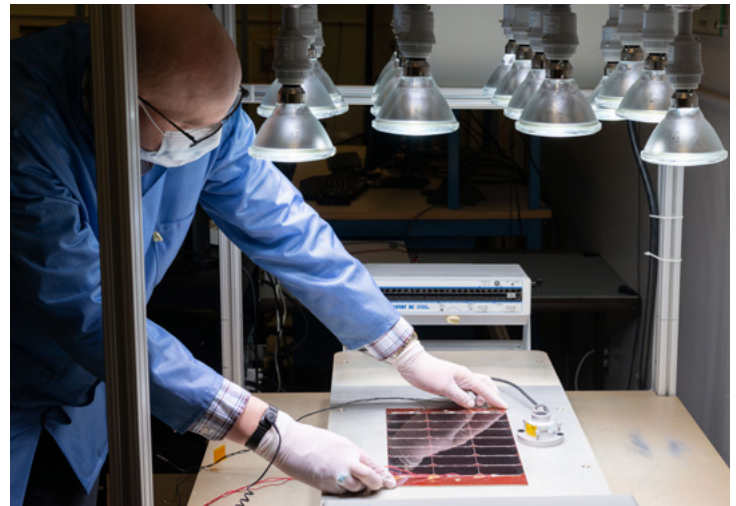
**The Attitude Determination and Control System (ADCS) test station** includes a 2 m Helmholtz cage with a 60 cm working volume capable of closed-loop magnetic field control within 100 nT in the range of +/- 100000 nT. A single-axis air bearing inside the cage with a high-resolution encoder enables torque verification for reaction wheels or magnetic actuators, static alignment and pole verification, and basic ADCS algorithm functionality tests. A star field simulator using the Hipparcos star catalog is also available for star tracker testing.

**The communications test station** includes software-defined ground radio equipment for UHF and S-band communications. This can be readily used with Cadet, Innoflight, Tethers Unlimited, and Iris radios to command spacecraft over-the-air within the SmallSat V&V Lab. A GPS reradiator is available to rebroadcast local signals from the visible GPS constellation within the lab. A GPS simulator is available to produce the output of the GPS constellation at any time and location, including on orbit.

**The power subsystem test stations** include a solar illumination simulator with a continuous AM0 light source to verify the power output of solar arrays to a class BBA (IEC 60904-9). A NIST-traceable pyranometer is used to measure the irradiance in the 3U x 3U target area. A solar array simulator supplies a programmable DC power source that simulates the output characteristics of a solar array. The simulator provides up to two outputs and up to 1200 W. An eight-channel automated battery tester is available for battery cycling of packs up to 60 V and 13 A. A battery simulator models lithium battery charge and discharge characteristics to enable functionality testing for electronic power systems.



*Functional testing at the ADCS station.*



*Solar panel illumination at the solar simulation station.*



*Battery simulation at the battery test station.*