

## Controlled Mechanical Environments for Testing High-Value Products



### Satellite Support Platforms

- Decouples satellite from facility
- Compatible with thermal-vac testing
- Optional latch and release



### Gravity Offload / Low Frequency Suspension

- Supports weight from above or below
- Payloads up to 15,000 kg
- Load leveling optional



### Flight Motion Simulators

- Six-axis motion control
- Hardware in the loop testing
- Optional, real-time interfaces

The process of satellite assembly, integration and test is exacting and requires considerable care. Our satellite support platforms make these necessary steps easier by providing mechanical mounting and decoupling from your facility and its sources of mechanical disturbance. Platforms incorporate vibration isolation and are compatible within atmospheric and thermal-vacuum environments. They allow handling within your facilities while protecting your satellite or major subsystem from harm.

Gravity affects structures differently on orbit but those structures must be integrated and validated on the ground. A compliant deployable appendage may be mass-optimized for in-space performance but unable to support its own weight on Earth. CSA's gravity offload systems provide low frequency suspension, with modes as low as 0.1 Hz, enabling you to test and validate space structures. With no sag, the suspension allows testing of fixed structures and additional features support structures with moving and deploying appendages.

Flight testing of spacecraft is rarely practical, and flight testing of missiles is expensive. CSA offers products that extend the fidelity of hardware-in-the-loop testing, incorporating more realistic aspects of flight including high frequency structural response. With six degree of freedom motion bases, you can evaluate image motion compensation algorithms and position test articles relative to other verification equipment. Embedded systems and a user interface provide multiple options for control and coordination with your other ground test systems.

## Why Invest in a Test Facility Product?

CSA's customers build sophisticated products and systems that must operate reliably for extended periods in harsh environments. Our customers and we both recognize the value of testing before the start of product operational lifetime. Traditionally, testing of space flight and other hardware has included thermal-vacuum and shake or vibration tests to screen or stress components. CSA offers a series of products that allow more comprehensive testing, simulating loads, vibration, boundary constraints, and other aspects of operational mechanical environments. These test facility products can be used to perform traditional stress tests. More commonly they allow our customers to do performance simulation by capturing essential features of operational environments and permit prolonged and comprehensive ground testing and refinement of subsystems including mechanical, electro-mechanical, electrical, and software elements. Our systems replicate the essential aspects of launch, flight, or on-orbit operation, and are compatible with other test facilities including vacuum chambers. They allow the gap between the real operating and synthetic environments to be narrowed so that risk is reduced, control ability is proven, and additional partial testing is avoided.





### Static Test for Launch Vehicle Structures

- Multi-axis load application
- Structures up to 5 meters
- Test adapters, inter-stages, fairings

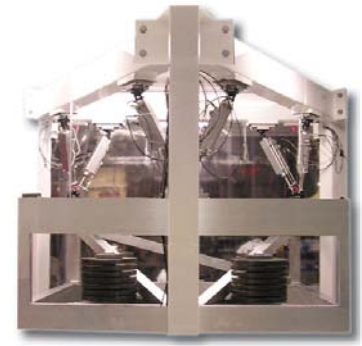
New launch vehicles, small satellites and evolving structural concepts drive the need for more sophisticated testing and qualification before flight. CSA operates a facility under a cooperative research and development agreement with the Air Force that allows us to test a variety of payload and interstage structures, fairings and interface cones. Developed initially to qualify the ESPA ring, the facility has been adapted to test multiple composite and metal structures. It allows for application of multi-axis loads simulating launch and includes extensive data acquisition. Custom fixtures augment the basic system for specialized tests.



### Large Vibration-Isolated Bench

- Flat optical bench (25 m long) for testing in vacuum
- Isolation system (1.5 Hz) with active leveling for moving payloads

When a major aerospace company began to develop a new vacuum test facility for large space optics it turned to CSA to provide vibration isolation. CSA delivered a large optical bench, more than 25 meters long supported by a soft isolation system. With suspension modes in the range of 1 to 2 Hz, the 250-ton bench is mechanically decoupled from the rest of the facility including pumps and other machinery, enabling a high fidelity representation of the space environment. CSA's product also provides load leveling to accommodate moving payloads on the bench, and a software monitoring system.



### Precise Positioners for Large Optics

- Six-axis motion control systems for inspection or assembly
- Options for range, speed precision
- Intuitive user interfaces

Space telescopes and other large optical systems require validation and verification before launch, and CSA provides precision positioning systems to support that ground test. These systems are based on our hexapod motion platforms, with resolution measured in micrometers or better. In vacuum chamber operation, the systems allow software-controlled alignment of test optics and flight components so assembly and performance of subsystems and complete assemblies can be proven. CSA's comprehensive product offerings incorporate mechanical, electromechanical, electrical, firmware and software elements to provide turnkey systems.

## Custom Test Facilities

Would you like to test a space component or system on the ground but it doesn't seem possible? CSA will work with you to understand your requirements and develop a custom system that builds on our established products. A long spar incapable of supporting its own weight? An array or antenna structure? A satellite robotic arm? CSA has supplied test systems for these and other structures.

Higher fidelity ground test can increase understanding of expected on-orbit performance, but gravity often gets in the way. CSA provides gravity offload systems that move to support extending and shape-changing structures so deployment mechanisms can be validated. We combine intricate mechanical design with actuation, sensing and electronic and software control to provide synthetic environments. An investment in ground testing reduces risk for flight and the need for additional analysis, design and testing using incomplete conventional methods and tools. Consider CSA when you want to manage motion and vibration for ground test of space systems.

