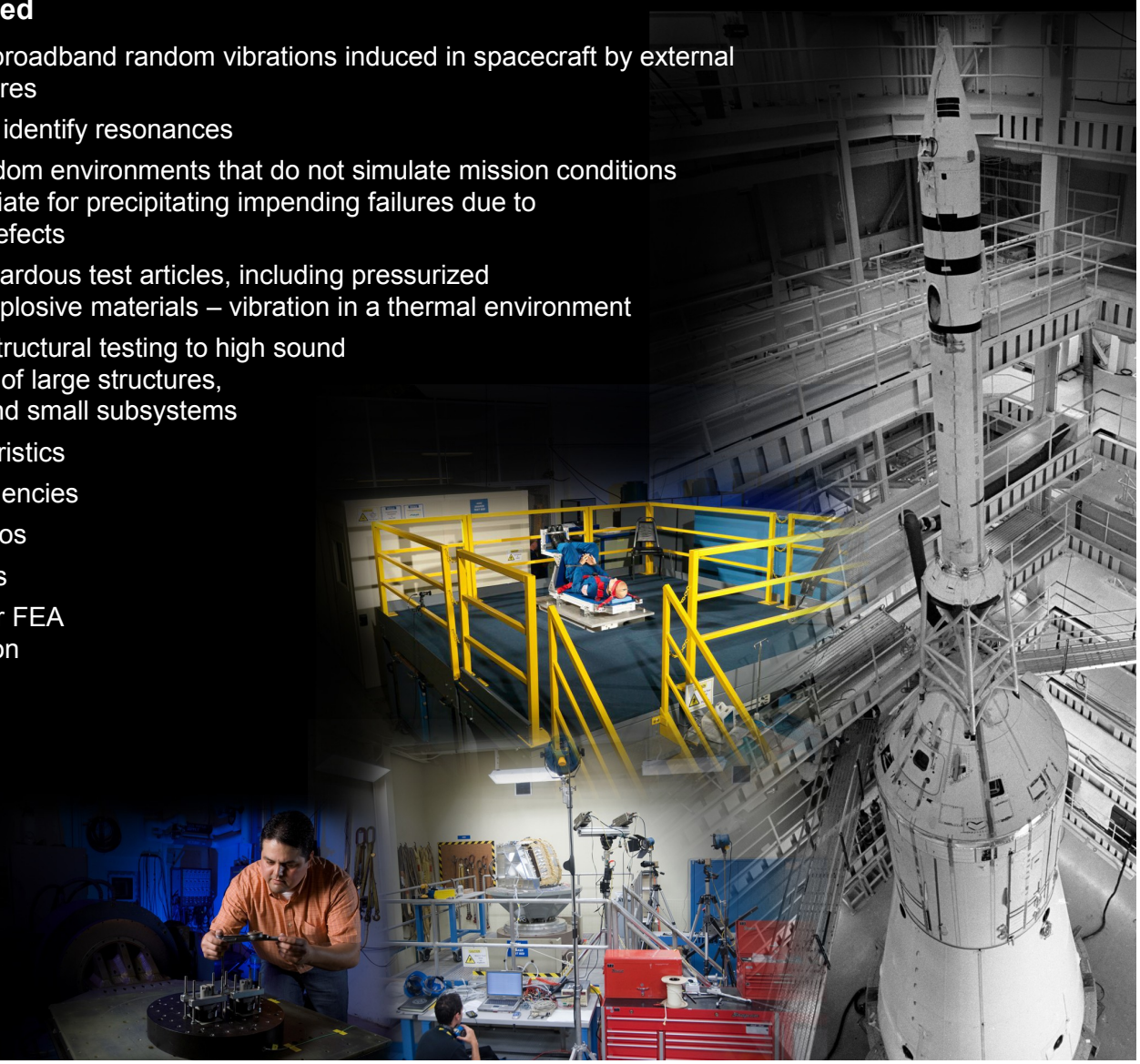
National Aeronautics and
Space Administration

Vibration Testing

Rocket boosters and spacecraft are subject to intense acoustic environments during launch, which induce high levels of vibration in structural elements and equipment. In addition, elastic structural interactions with propulsion systems and flight control systems can produce low-frequency, high-deflection flight instabilities. Johnson Space Center (JSC) offers a wide range of tests needed to evaluate all aspects of structural dynamics, including vibration, vibroacoustics, modal characteristics, sound transmission loss, and shock testing. Ground testing to simulate launch-induced vibration or to investigate structural dynamic characteristics has proven to be vital in developing successful spacecraft programs. JSC facilities provide the capability to perform test and evaluation of both aerospace and nonaerospace hardware.

Services Provided

- Simulations of broadband random vibrations induced in spacecraft by external acoustic pressures
- Sine sweeps to identify resonances
- Broadband random environments that do not simulate mission conditions but are appropriate for precipitating impending failures due to workmanship defects
- Vibration of hazardous test articles, including pressurized systems and explosive materials – vibration in a thermal environment
- Vibroacoustic structural testing to high sound pressure levels of large structures, components, and small subsystems
- Modal characteristics
  - Natural frequencies
  - Damping ratios
  - Mode shapes
- Mathematical or FEA model correlation



Vibration Testing

Facility	Frequency Range	Shaker Size Range	Load Direction	Displacement
General Vibration Laboratory (GVL)	5 – 3000 Hz	4,000 – 40,000 lb_f	x, y, or z	1” to 2” peak-to-peak
Spacecraft Vibration Laboratory (SVL)	5 – 2000 Hz	50 lb_f shakers up to 8 x 10,000 lb_f shakers	x, y, or z	2” peak-to-peak
Hazardous Vibration Test Stand	20 – 2000 Hz	11,000 lb_f RMS Up to 16,000 lb_f sine Up to 15,500 lb_f random	x, y, or z	1” stroke

General Vibration Laboratory

The GVL has five primary testbeds; however, unique testbeds can be constructed as necessary to meet a specific test project. Inside the GVL enclosure (removable ceiling panels), the 40,000 lbf shakers for the vertical and horizontal testbeds are mounted to seismic floors. Outside the GVL enclosure are two more testbeds, an 18,000 lbf vertical testbed and a 20,000 lbf horizontal testbed. The GVL also houses a 8,000 lbf human-rated vibration testbed. The laboratory typically provides testing for subsystems and smaller components from as large as an aircraft rudder to as small as a 4 oz heart rate monitor.

Spacecraft Vibration Laboratory

The SVL was specifically designed for vibration testing of large structures and used for Apollo, Skylab, Space Shuttle, and Space Station tests. It provides a vast array of access platforms to the test articles. Massive test articles can be supported by pneumatic springs and subjected to high-force inputs, which simulate rocket-induced discrete-frequency or random loads with distributed mechanical shakers. Typical testing functions performed include high-force vibration (random and sine), shock vibration, and fixed-base and free-free modal testing.

Hazardous Vibration Test Stand

The Hazardous Vibration Test Stand provides for vibration of pressurized systems and explosive materials and vibration within a thermal environment. The test stand supports test articles (including fixture) up to 2,000 lb. Vibration capability includes sine, random, and classical shock.

Vibroacoustic Testing

Facility	Facility Size	Sound Pressure Level
Spacecraft Acoustic Laboratory	Chamber size: ~39’ x 47’ x 75’ high Ceiling can be lowered to ~33’ high	High Ceiling 152 dB (current) 162 dB (future) Low Ceiling 155 dB (current) 165 dB (future)
Sonic Fatigue Laboratory	Chamber size: ~19’ x 40’ x 16’	158 dB (current) 167 dB (future)

Modal Test and Analysis

- Input Excitation – Flexible
  - Sine, random, burst random/chirp, sine on random (shaker driven)
  - Impact (impact hammer driven)
  - Operational (vibrating) test article
- Shakers – Wide Array
  - Up to 500 lb capacity with single or multiple shakers
  - Impulse hammers available
- Boundary Condition Capability – Fixed-Base, Free-Free
  - Large seismic mass bases up to 20,000 lbs.

We have developed customer-friendly agreements to streamline business relationships and are eager to share our unique facilities and expertise with new customers. We invite your inquiries regarding application or adaptation of our capabilities to satisfy your special requirements. Briefings on general or specific subjects of mutual interest can be arranged at JSC or at your business site.

Facility Testing Information
http://jsceng.nasa.gov

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FS-2011-07-043-JSC