Does your hardware need to work in extreme pressure or temperature environments? Will it undergo severe vibration, shock and load conditions? Or, will it encounter electromagnetic interference? Ball Aerospace’s Environmental Test Facilities can provide the space, resources and specialists needed to test your hardware in all the environments it may encounter.

**CLIMATICS LAB**

The Climatics Lab can simulate high temperature and/or high altitude environments, as well as provide thermal cycling, corrosion, air bake, cure and humidity tests. Additionally, procedures have been put into place to protect and test hardware sensitive to electrostatic discharge. The Lab’s nine chambers are staffed and operated 24/7 to provide ample resources that meet the needs of our customers.

The chambers vary in size from an 18 in. by 17 in. by 15 in. test volume to a 48 in. by 48 in. by 48 in. test volume. Ramp rates vary by chamber; all chambers are controlled by a 2704 Eurotherm Process Controller and collect data using an Agilent Data Acquisition Unit. Additionally, downflow tents are available for loading and unloading hardware. Specific test parameters include:

- Thermal cycling: -165°C to 260°C (varies by chamber)
- Altitude: sea level to 65,000 ft.
- Humidity control: 20% to 95%; RH 5°C to 80°C

**STANDARDS AND SPECS**

- MIL-STD-202
- MIL-STD-810

**POINT OF CONTACT**

Environmental Test at Ball Aerospace

batcTestOps@ball.com
Ball’s state-of-the-art Fisher Test Facility in Boulder, Colo., can build and test spacecraft, instruments, space and airborne antennas, ground support equipment and more for a myriad of environments, including transport, storage, launch, flight and on-orbit operation. Our capabilities allow us to affordably test hardware, while easily accommodating our customers’ schedules. Ball’s testing facility includes an Electromagnetic Interference and Compatibility (EMI/EMC) Lab, Dynamics Lab, Thermal Vacuum Lab and Climactics Lab.

**OVERVIEW**

The EMI/EMC Lab combines skilled EMC specialists with exceptional facilities to provide for all phases of military and commercial EMI/EMC testing, including emission and susceptibility testing. The lab features a sterile environment free from ambient radio frequency interference (RFI), as well as shielded anterooms for ground support equipment. Additionally, the lab utilizes the Rohde & Schwarz test data and analysis system for emission testing and the ETS Lindgren TILE!™ automated software for susceptibility data and analysis system for emission testing and the ETS Lindgren TILE!™ automated software for susceptibility testing. Specific test parameters include:

- Emission and susceptibility testing: nominally 10 KHz to 18 GHz (18 GHz to 40 GHz available upon request)
- Filtered power 100 dB insertion loss from 14 KHz to 10 GHz
- Welded, steel construction provides:
  - E-Field attenuation: 100 dB from 10 KHz to 10 GHz
  - H-Field attenuation: 30 dB at 1 KHz, 95 dB at 100 KHz
  - Plane wave attenuation: 100 dB from 100 MHz to 10 GHz

**STANDARDS AND SPECS**

- MIL-STD-202
- MIL-STD-810
- MIL-STD-154
- NASA-STD-7003

**DYNAMICS LAB**

The Dynamics Lab simulates the vibration, shock and load conditions that hardware might experience during space launch, high altitude flight, super-sonic flight, collisions, rough terrain and more. During and after testing, the Lab analyzes the performance of the hardware with real-time data analysis (i.e., IDEAS 6.4 and Brüel & Kjær) and post-processing (i.e., Power Spectral Density (PSD), Frequency Response Functions (FRF), Shock Response Spectrum (SRS), time history and a variety of complex mathematical functions), respectively.

Additionally, the Lab features a variety of accelerometers, force transducers and laser vibrometers to meet your data acquisition needs. HEPA Class 7 down flow tents and a 20-ton crane with a 30-ft. hook height are available to protect and install your hardware. Specific test parameters include:

- Vibration: random, sine, mixed mode, sine burst
- Shock: simulated, pyrotechnic and classical
- Loads: dynamic, static
- Modal Survey: development of finite element and test analysis model
- Accelerometer, force and moment limiting

**STANDARDS AND SPECS**

- ASTM-E2900
- ASTM-E512
- MIL-STD-810
- DO160

**THERMAL VACUUM LAB**

The Thermal Vacuum Lab can simulate extreme pressure and temperature environments for all types of products, ranging from small cables to full-size satellites. With 24/7 monitoring, this state-of-the-art control facility can perform high temperature bakeout, thermal cycling and helium leak detection.

The Vacuum Lab features 15 chambers of various sizes, ranging from a chamber with an 11 in. by 14 in. base with 9 in. to shroud height to a chamber with a 20-ft. diameter and a height of 24 ft. All vacuum chambers pump down to 1x10^-6 Torr with ramp rates of 1.5° C per minute at 1x10^-6 Torr. The larger chambers are equipped with HEPA Class 7 (10,000 cfm) down flow tents. Although temperature range differs by chamber, the Vacuum Lab can simulate an overall temperature range of -196° C to 175° C.

In addition, the Vacuum Lab provides forklifts and cranes for loading hardware into chambers and features various feed through ports for electrical, optical, RF and thermal connections to test the article. Residual Gas Analyzers, Thermal Quartz Crystal Microbalance (TQCM) contamination monitoring and thermal vacuum cameras are available upon request.

**STANDARDS AND SPECS**

- ASTM-E2900
- ASTM-E512
- MIL-STD-810
- DO160

**EQUIPMENT**

**EMI/EMC LAB**

- Large Semi-Anechoic Chamber
  - Size: 26 ft. by 40 ft. by 20 ft. (without cone)
  - High Efficiency Particulate Air (HEPA) filtered to Class 7 (10,000 cfm) particulate contamination

- Small Shielded Chamber
  - Size: 20 ft. by 16 ft. by 12 ft. (without cones)
  - Door: 5 ft. by 6 ft. bladder seal

**DYNAMICS LAB**

- 50,000 lbf Shaker
  - Horizontal slip tables: 60 in. by 72 in., 36 in. by 36 in.
  - Vertical tables: 60 in. by 60 in., 36 in. by 36 in.
  - Acceleration: Up to 133 g.
  - Velocity: Up to 90 ips

- 30,000 lbf Shaker
  - Horizontal slip tables: 60 in. by 72 in., 36 in. by 36 in.
  - Acceleration: Up to 133 g.
  - Velocity: Up to 70 ips

- 20,000 lbf Shaker
  - Horizontal slip tables: 36 in. by 36 in.
  - Vertical tables: 32-in. diameter
  - Acceleration: Up to 209 g.
  - Velocity: Up to 80 ips

- Shock Table
  - SRS Shock to 5,000 g
  - Test articles with a base up to 30 in. by 30 in. and weight up to 300 lb. 3-axis shock testing

- Modal Mass
  - 30 ft. by 30 ft. slab
  - 570,000 lb. working load