

# Electromagnetic Spectrum (EMS) Systems Test

**Benefield Anechoic Facility**



*Flying in the BAF...*



U.S. AIR FORCE

# Benefield Anechoic Facility (BAF) Electromagnetic Spectrum (EMS) Systems Test



The BAF is located at Edwards Air Force Base, California. It is the largest anechoic test facility in the world—providing a “virtual open-air range (OAR) within four walls and ceiling.” It is capable of supporting and handling virtually all Department of Defense (DoD) aircraft, with very few exceptions, to test their radio frequency (RF) systems for wide-ranging EMS installed systems test. The primary purpose the BAF serves is the test and integration of avionics systems in a secure, and repeatable electromagnetically controlled free-space environment, using state-of-the-art simulation and stimulation technology, that closely duplicates the real combat mission environment.

At the BAF, the 772 Test Squadron provides comprehensive systems and test engineering applied to the developmental T&E of military and commercial RF systems. With the increased demand posed by integrated, EW/IO and net-centric RF systems and their required interoperability and compatibility, it is a valuable tool for today’s highly integrated weapons systems.

### Physical Characteristics and Support

- 264 ft. L x 250 ft. W x 70 ft. H
- 175-ton, 80 ft. diameter turntable
- Two (2) 40-ton hoists

### Anechoic Chamber RF Characteristics

- RF shielding from external environment:  $\geq 100$  dB (0.01 – 18 GHz)
- Typical quiet zone isolation
  - 0.5 GHz\*  $\geq 72$  dB
  - 1.0 GHz  $\geq 84$  dB
  - 2.0 GHz  $\geq 96$  dB
  - 3.0–18 GHz  $\geq 100$  dB

\*Below 0.5 GHz desirable quiet zones are achieved with case-by-case configurations and special techniques used to isolate the system-under-test (SUT) from potential undesirable chamber reflections.

### Chamber Applications and Functionality

- An exclusively large anechoic chamber facility
- Complete end-to-end installed systems test in a free-space environment
- Dense, high fidelity RF threat simulation and verification
- Electronic countermeasures collection, measurement and analysis
- Radar target return and ECM simulation for FCR and ECCM tests
- Antenna pattern measurement
- Intra- and Inter-Systems Electromagnetic (EM) Interference and Compatibility (EMI/EMC)

- Electromagnetic environmental effects (E3) measurements
- Global positioning system (GPS) signal simulation and test
- Proficient RF, EW systems and systems test engineering expertise and know-how
- State-of-the-Art RF, digital and video instrumentation infrastructure

### Typical Manned and Un-manned Vehicle Systems Tested

- SIGINT and ELINT systems
- Network centric systems of systems
- Communications and navigation
- Identification friend and foe (IFF)
- GPS (including anti-jam and CRPA)
- Radar systems
- Radar warning receivers (RWRs)
- Electronic Countermeasures (ECM) (On-board and off-board)

### EW RF Threat Simulation and Generation

- Frequency range: 100 MHz – 18 GHz
  - High fidelity, high density\* Combat Electronic Environment Simulator (CEESIM) based
  - Direct Injection or free-space radiation at the SUT
  - 24 Individual channels (either dedicated or multiplexed)
  - 360° azimuth coverage
  - Variable elevations based on SUT-Chamber geometry
  - Dynamic user-defined scenarios
  - SUT receive antenna characteristics
- \* The number of simultaneous threats depends on the duty cycle of the chosen emitters and the desired fidelity of the simulation (e.g., 1.35 million pulses per second with 10 CW emitters and a dropout of  $\leq 3\%$ ).

### Communication, Navigation and Identification

- Frequency Range: 20 MHz – 2 GHz
- Direct Injection or free-space radiation at the SUT
- High fidelity, high density Joint Communications Simulator (JCS) based
  - 72 simultaneous RF emitters (pulsed signals timeshared)
  - 2000 emitters in a scenario
  - IFF: Interrogations and replies (AIMS Certification (JCS) - modes 1, 2, 3A, 4, 5, and S)
- All 72 free-space signals can be added as background

### Data Link Capabilities

- Ku-Band SATCOM Link provides remote monitoring and control of UAVs or RPVs from customer mission control centers
- Link-11/16 Multi-Link System Test & Training Tool (MLST<sup>3</sup>) –

- includes error message generation
- Link-16 Advanced Communications Environment – Faithful Timeslot Messaging (ACE-FTM)
- Link-16 Environment Gateway Simulator (LEGS)
- Link-16 Management System (LMS-16) data capture of RF transmissions
- Commanders Tactical Terminal (CTT) Integrated Broadcast Service – Interactive (IBS-I)

### Electromagnetic Interference/Electromagnetic Compatibility

- Source – Victim scenarios (antenna isolation or coupling)
- High Intensity Radiated Fields (HIRF), Radiation Susceptibility
- Radiated Emissions (EMCON), Conducted Emissions

### Antenna Pattern Measurement

- Stand-alone and installed antenna measurements
- Quantifies the system antennas field of view in an installed configuration.
- Large or fighter-sized aircraft
- Rapid automated phase and amplitude collection
- Polarizations: RHCP, LHCP, Vertical, Horizontal, Slant, and Axial Ratio

### Data Processing & Instrumentation Resources

- Real-time displays of data from SUT, chamber videos and data measuring/collecting systems in state-of-the-art test control room
- Monitor/record up to 2 PCM, RS422, RS232 and 8 Mil-Std-1553B
- Threat generation activity files
- Time correlated data files
- Data formats and media as requested by customer

### Support Utilities Systems

- Aircraft Electrical Power:
  - 400Hz AC
  - 270VDC (Supports F-22 and JSF)
  - 28 VDC
- Instrumentation Power: 28VDC
- Liquid cooling: PAO, EGW and Coolanol
- Air cooling
- Two hydraulic systems

### Security

The BAF is designed to meet classification levels of test programs. Additional security measures are implemented if the test program has special security requirements.



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