Live Fire Test and Evaluation Program

EXECUTIVE SUMMARY

U.S. Code Title 10, Section 2366, requires realistic survivability testing of major conventional air, land, and sea platforms and realistic lethality testing of major munitions and missile systems. Title 10, Section 139, states that the Director, Operational Test and Evaluation (DOT&E) shall monitor and review the Live Fire testing activities of the DoD provided for in Section 2366, and requires DOT&E to prepare an annual report summarizing the operational test and evaluation activities (including Live Fire testing activities) of the DoD during the preceding fiscal year. This section of the DOT&E Annual Report to Congress satisfies the requirement for an annual Live Fire Test and Evaluation (LFT&E) report.

In FY09, DOT&E executed oversight for survivability and lethality of 128 acquisition programs. Of those 128 programs, 20 programs operated under the waiver provision as permitted by Section 2366. Title 10, Section 2366 requires DOT&E to report on a program's LFT&E results prior to proceeding to full-rate production. LFT&E published the following reports in FY09: EA-18G Airborne Electronic Attack Aircraft, Guided Multiple Launch Rocket System – Unitary, Logistics Vehicle System Replacement, and MH-60S Block 3A Armed Helicopter Weapon System.

In addition to satisfying acquisition program oversight requirements (Title 10, Section 2366), the LFT&E program funds and exercises technical oversight of investment programs that provide joint munitions effectiveness data; develop advanced technologies and analytical methods to increase aircraft survivability; conduct vulnerability test and evaluation of fielded air, land, and sea platforms; and, conduct munitions lethality testing. LFT&E investment programs also support quick-reaction efforts aimed at addressing emerging warfighter needs. Specifically, LFT&E investment programs enabled DOT&E to respond to these warfighter needs in FY09 as follows:

- **Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME)** The JTCG/ME publishes weapon effectiveness manuals, collateral damage estimation tables, methods, and automated tools that enable the weaponeering and mission planning processes. DOT&E oversight of the JTCG/ME and its connection to acquisition programs ensures that weapons effectiveness data are available to warfighters when the Services field new weapons.
  - The JTCG/ME continues the critical task of producing Joint Munitions Effectiveness Manual (JMEM) weaponeering and collateral damage estimation products in support of mission planning and execution by all combatant commands and Joint and Service staffs in all theaters of current operations including Operations Enduring Freedom (OEF) and Iraqi Freedom (OIF).
- **Joint Aircraft Survivability Program (JASP).** The JASP serves as the DoD's focal point for aircraft survivability, establishing survivability as a design discipline and furthering the advancement of aircraft survivability by investing in development and implementation of new technologies.
  - The Joint Combat Assessment Team (JCAT) of the JASP continued its deployment to OIF in support of Combined Forces Aviation. JCAT continued operations from bases in Al Asad, Balad, and maintained a senior uniformed presence with Multi-National Corps-Iraq C3 Air at Camp Victory in Baghdad. In support of OEF, JCAT established an Afghanistan detachment in Kandahar. JCAT uses data gathered from combat, threat exploitation, and Live Fire testing to provide combat commanders information that influences mission planning and tactics.
- **Joint Live Fire (JLF).** The Office of the Secretary of Defense established the JLF program in 1984. JLF tests and evaluates fielded U.S. systems against realistic threats. The program places emphasis on addressing urgent needs of deployed forces, testing against emerging threats, and testing legacy systems and identifying areas for improvement. DOT&E funds, establishes goals and priorities, and oversees the efforts of the JLF program.
  - During FY09, JLF continued its support to the Joint Improvised Explosive Device Defeat Organization (JIEDDO) and to the Army's Program Executive Office (PEO) – Soldier. In partnership with JIEDDO, JLF continues to characterize improvised explosive munitions in environments and emplacements that represent actual combat conditions. Test results provide combat commanders immediate feedback on their vulnerabilities and aid in the development of techniques to improve survivability. In partnership with the Army's PEO - Soldier, JLF funded critical combat helmet pad suspension system testing with the objective of identifying viable candidates for a next generation of helmet pads. This work is critical to the survivability of our warfighters and has also been an area of high interest to the Congress.

JOINT TECHNICAL COORDINATING GROUP FOR MUNITIONS EFFECTIVENESS (JTCG/ME)

The Joint Logistics Commanders chartered the Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME) in 1968 to ensure development of consistent, credible effectiveness estimates for conventional munitions across the DoD. The primary application is weaponeering, the detailed technical planning of a weapon strike that occurs at multiple levels in the operational chain of command before actual combat. The JTCG/ME produces, distributes, and regularly updates Joint Munitions Effectiveness Manuals (JMEMs). JMEMs provide computerized operational tools and data for rapid evaluation of alternative weapons and their delivery against specific targets. In many cases collateral damage estimates generated by these tools are part of the decision criteria for strikes approved at the highest levels of the U.S. Government.

In FY09, the JTCG/ME developed and released two updated JMEMs. The first was the JMEM Weaponeering System (JWS) v2.0 (1,400 copies to 900 accounts). JWS v2.0 represents a combination of the formerly separate JMEM/Air-to-Surface Weaponeering System and JMEM/Surface-to-Surface Weapons Effectiveness products. It includes target vulnerability information for approximately 1,500 targets; descriptive information, data, and graphics; computer programs and methods needed to accomplish weaponeering; step-by-step guides to weaponeering, and Help files. JWS v2.0 provides the capability to evaluate the effectiveness of various air to surface and surface to-surface weapons against a variety of target types. The results are available in real-time or in the form of quick, pre-calculated data. The JTCG/ME sponsored training on the v2.0 software to over 300 users at over a dozen key continental U.S. (CONUS) and outside-CONUS operational sites. In addition, the JTCG/ME continued to provided direct support to Central Command and the Joint Staff "No-Strike and The Collateral Damage Estimation Methodology" process. The JTCG/ME provided data updates concurrent with deployment of rapidly fielded weapon systems supporting operations in OIF and OEF.

The second product released by JTCG/ME was the Joint Anti-Air Combat Effectiveness (J-ACE) System v4.0 that contains the Joint Anti-Air Model. J-ACE can read Eglin test range information data files and incorporates new Threat Modeling and Analysis Program models for enemy air-to-air missiles and surface-to-air missiles. The models also perform logic checks for maximum off bore sight launch angle limits. Additionally, J-ACE v4.0 contains new AIM-9M/X and AIM-120C effectiveness data and architectural and graphical user interface improvements. This JMEM is used by fighter pilots to develop air superiority tactics and by Strategic Command for global strike mission planning.

The JTCG/ME continued JMEM development efforts to support Information Operations. Specifically these efforts, performed in coordination with the United States Strategic Command and various Government Agencies, resulted in enhancement to the Computer Network Attack Risk and Effectiveness Analyzer and various Psychological Operations tools. Information Operations training was conducted at numerous locations. Initiatives related to JMEM development for other non-traditional effects (e.g., non-lethal, High Energy Laser, High Power Microwave) continue. In conjunction with the Joint Non-lethal Weapons Directorate at Quantico, Virginia, the JTCG/ME produced a beta version of the first-ever Joint Non-lethal Assessment Tool.

JOINT AIRCRAFT SURVIVABILITY PROGRAM (JASP)

The mission of the JASP is to increase the effectiveness of DoD aircraft by developing technology to reduce the susceptibility and vulnerability of aircraft. JASP provides inter-Service exchange of information regarding the survivability of aeronautical systems in combat environments. Working with joint and Service staffs, other government agencies, and industry, the JASP identifies opportunities to develop new capabilities and works to assure they are pursued jointly by the Services.

JASP is sponsored and funded by DOT&E and chartered by the Naval Air Systems Command, Army Aviation and Missile Command, and Air Force Aeronautical Systems Center. DOT&E establishes objectives and priorities for the JASP and exercises oversight of the program.

In FY09, the JASP worked with OUSD(AT&L) to conduct a congressionally-directed Study on Rotorcraft Survivability (Section 1043, 2009 National Defense Authorization Act). The multi-disciplinary study team led by the JASP determined rotorcraft loss rates and causal factors, and recommended solutions for combat losses as well as losses due to mishaps. The study report was signed by OUSD(AT&L) on October 2, 2009, and delivered to Congress.

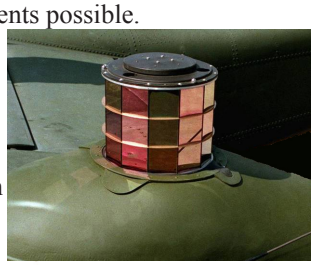
The JASP continued to work with the defense acquisition community, the Department of Homeland Security, the Federal Aviation Administration, the Transportation Security Administration, and the National Aeronautics and Space Administration to address critical issues regarding aircraft survivability. Accordingly, JASP funded 53 multi-year survivability projects for $9.8 Million and delivered 40 reports in FY09. The following summaries illustrate current JASP efforts in four focus areas; susceptibility reduction, vulnerability reduction, survivability assessment, and combat damage assessment.

SUSCEPTIBILITY REDUCTION

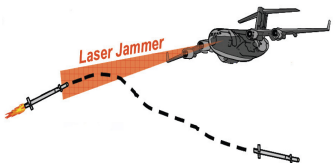
The JASP continues as a leader in DoD susceptibility reduction science and technology efforts. These efforts address urgent aircraft survivability needs emerging from OEF/OIF and improve aircraft survivability against future threats.

Below are example projects in each focus area.

Correlation of Seeker Test Van Data with Intelligence. Discrepancies discovered between flight test results and intelligence estimates have significant implications for survivability, tactics, and countermeasure deployment against infrared Man-Portable Air Defense Systems (MANPADS) threats. The JASP is investigating these discrepancies to provide the most accurate seeker effectiveness assessments possible.



Imaging Infrared Seeker Countermeasures. With JASP support, the Naval Research Laboratory continues to develop countermeasures against missiles with Imaging Infrared seekers. In FY09, several promising countermeasure techniques were developed using digital modeling and simulation. The project will complete in FY10 after the technique's effectiveness can be verified using hardware-in-the-loop simulation facilities.



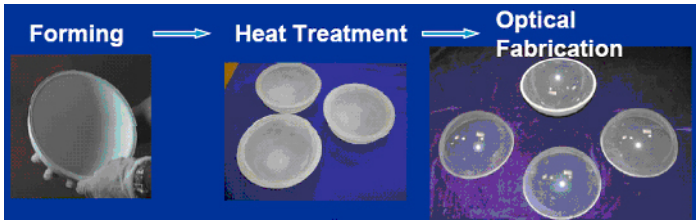
Advanced Techniques for Radio Frequency Countermeasures. In partnership with the U.S. Army Communications-Electronics Research, Development, and Engineering Center, Intelligence and Information Warfare Directorate, the JASP is supporting the development and testing of countermeasures technology and techniques to increase aircraft survivability and situational awareness for Army, Navy, and Air Force rotary-wing aircraft. This project assesses the ability of an onboard radar warning receiver to receive, process, and display each mode of a threat system. It also develops radio frequency countermeasure techniques and demonstrated their effectiveness against a state-of-the-art threat radar system. The first year of the project, FY09, was successful and the techniques developed during that effort are already being transitioned to the Services.

Passive Coherent Location (PCL) Countermeasures. PCL systems can use existing military and commercial transmitter signals (e.g., TV/radio broadcast signals, air traffic control radars, etc.) as target "illuminators of opportunity." Open sources around the world show an increasing interest in PCL as a way of passively tracking aircraft on the battlefield. In response, the JASP and the Office of Naval Research are funding efforts to develop and demonstrate techniques to deceive, obscure, and/or jam a surrogate PCL system without disrupting or interfering with commercial transmitters. These electronic attack (EA) techniques, if effective, provide a new EA capability to protect strike aircraft against these passive threats.

VULNERABILITY REDUCTION

The JASP maintained its role as the leader within the DoD for the development of aircraft vulnerability reduction technology. In FY09, the JASP continued to focus on developing lighter-weight opaque and transparent ballistic protection systems, fuel containment technologies for fuel system components, and fire protection technologies.

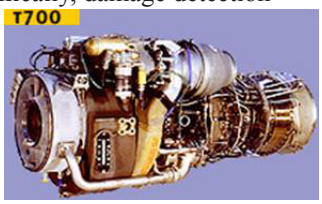
Development of Transparent Armor Systems. The Army Aviation Applied Technology Directorate, together with BAE Systems, demonstrated transparent armor concepts for rotorcraft that yielded a 30 percent weight reduction over current systems while lowering manufacturing costs and substantially improving multiple-hit performance. Specifically, various transparent inorganic materials, bonded to a lightweight urethane substrate (Cleargard® variants), were ballistically tested and modeled. The project matched indices of refraction between multi-component materials and quantified improvements over the baseline transparent armor system.



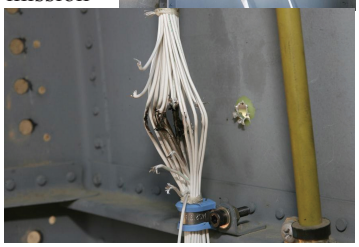
Joint Thermal Degradation of Composites. The 780th Test Squadron at Wright-Patterson Air Force Base (WPAFB), together with the Air Force Research Lab and the Naval Air Systems Command, continued quantifying the degradation of aircraft structural composite materials as a function of the thermal flux caused by short-lived fuel fires.

Wireless Fire Detector. The 780th Test Squadron at WPAFB continued work to develop a wireless fire detector for plug and play application in emerging and legacy aircraft. The goal of this effort is to produce a low-cost, lightweight, fast-acting and reliable fire protection system that is easy to retrofit into fielded aircraft.

Survivable Engine Control Algorithm Development (SECAD) Turboshaft Application. The Naval Air Warfare Center Weapons Division (NAWCWD) at China Lake, California, together with General Electric Aircraft Engines, completed applying the SECAD methodology to turboshaft engines in cooperation with the T-700 Project Office. Specifically, damage detection algorithms were developed for integration into the Full Authority Digital Electronic Control controls on the UH-60M helicopter and bench-tested on the real-time hardware-in-the-loop T-701E engine simulator.



Electrical Power Battle Damage. The project goal is to characterize electrical system response to battle damage with and without improved circuit breakers, and to confirm the improved system response through live fire testing. The Naval Air Warfare Center Aircraft Division at Patuxent River, Maryland, is improving the process of isolating the damage and rerouting power of the H-60 helicopter in order to preserve the aircraft's mission capability.



Joint Flare Dispenser Vulnerability Reduction. NAWCWD continued to investigate and test novel technologies to reduce the effects of ballistically induced flare initiation in internally installed countermeasure flare dispensers. The goal is to develop technology that is lightweight, low-cost, and capable of installation on currently fielded and future aircraft. Effectiveness is measured by the ability to reduce pressure and temperature in an adjoining dry bay of a representative airframe.

SURVIVABILITY ASSESSMENT

The JASP has led the effort in DoD to develop of aircraft survivability assessment methodologies.

Crew and Passenger Survivability (CAPS) Methodology. In FY09, the JASP initiated an effort to improve the survivability of crew and passengers in aircraft that cannot make a normal landing due to combat damage. The goal is to develop a methodology that predicts the probability and number of casualties, crash conditions at landing, and crash effects on passengers and crew.

The project began with a workshop in January 2009 to identify methodologies and data relevant to aircraft occupant casualties of all types. The workshop participants included representatives from each Service, as well as other government organizations including the National Transportation Safety Board, the National Highway Transportation Safety Agency, and NASA. The data and ideas from the workshop will be documented in a report and used to develop an initial CAPS methodology.

COMBAT DAMAGE ASSESSMENT

During FY09 the Joint Combat Assessment Team (JCAT) deployed Navy, Army, and Air Force personnel in support of OIF. JCAT-Forward locations included Al Asad Air Base in the western Al Anbar Province, Balad Air Base north of Baghdad, and Camp Victory, Baghdad. JCAT expanded its operations into Afghanistan, deploying Army, Marine Corps, and Navy assessors to OEF. An initial full-time deployment was established with the Marine Corps at Camp Bastion.

JCAT support includes inspecting damaged or destroyed aircraft, acquiring available maintenance documentation, and conducting interviews with aircrew and intelligence personnel. Consultation is provided to weapons, tactics, and logistics personnel and comprehensive briefings are given to commanders in charge of daily air operations. These efforts provide valuable information to commanders allowing them to adjust their tactics, techniques, and procedures based on accurate threat assessments. These efforts included 1,416 days of effort of which 1,274 days were forward deployed in Iraq and Afghanistan resulting in the completion of 50 aircraft evaluations and reports.

The Army component of JCAT developed Combat Battle Damage Collection and reporting requirements for Army Aviation. The Army JCAT intends to provide deployed warfighters with a reporting link accessible via the United States Army Aviation Center of Excellence web site. This link will expedite timely battle damage reporting and feeds the Combat Damage Incident Reporting System (CDIRS) hosted by the Survivability/ Vulnerability Information Analysis Center (SURVIAC). The JCAT continues to work closely with SURVIAC to upgrade the CDIRS database and data reduction capabilities. This SURVIAC database is the repository for all U.S. aircraft battle damage events.

The JCAT provides professional training to the U.S. aviation community. JCAT Army members hosted the 2009 Threat Weapons and Effects Seminar at Eglin Air Force Base, Florida, with almost 200 survivability experts and Service personnel in attendance. Attendees included industry partners and 12 U.S. government agencies including all four U.S. military services, Department of State, Department of Homeland Security, Federal Aviation Administration, Department of Energy, Federal Bureau of Investigation, and the Bureau of Alcohol, Tobacco, Firearms and Explosives.

The JCAT provides a number of briefings in each of the Professional Military Education classes at Fort Rucker, Alabama.

The briefs include but are not limited to: capabilities briefs, intelligence updates, recent "shoot-down" briefs to discuss enemy tactics, techniques, and procedures, and the combat damage collection and reporting mentioned above. The attendees at these briefings range from individual crewmembers to the Vice Chief of Staff, U.S. Army. In FY09, JCAT Army conducted over 140 such briefs to over 4,000 Service members.

JCAT led the effort to prepare the DoD response to the congressionally-directed Study on Rotorcraft Survivability (Section 1043, 2009 National Defense Authorization Act). JCAT aircraft combat damage reporting in OIF and OEF was critical to understanding the combat survivability of DoD's rotorcraft fleet.

JOINT LIVE FIRE (JLF)

The Joint Live Fire Program consists of three groups: Aircraft Systems (JLF/AS), Armor/Anti-Armor (JLF/A/AA), and Sea Systems (JLF/SS). Following are examples of projects funded by JLF.

AIRCRAFT SYSTEMS PROGRAM

U.S. helicopters continue to be subject to hostile fire. Owing to previous survivability enhancements, the majority of the aircraft that receive combat damage return to base, are quickly repaired, and return to flying status. However, some are lost, primarily due to missile (both guided and unguided) hits and small arms/heavy machine gun projectiles. Many times in-flight fires resulting from hostile fire bring aircraft down. The goal of the Aircraft Systems Program is to identify vulnerable areas in current aircraft platforms, understand damage mechanisms, and provide this information to survivability engineers. In FY09, JLF Aircraft Systems (JLF/AS) began several large multi-year projects to deal with the MANPADS threat and assess the vulnerability of rotary-wing aircraft to threat-induced fires. These are discussed below.

CH-46 Fuel Line Fire Protection. The mission of the CH-46 helicopter is to provide all-weather transport of combat troops, supplies, and equipment during amphibious and subsequent operations ashore. As early as 1966 in Vietnam, the CH-46 was shown to be vulnerable to small arms projectiles and fragments penetrating pressurized fuel lines, causing catastrophic fire. As late as 2007 in Iraq, a fuel line fire is thought to be a major contributing factor in the loss of aircraft and all passengers after a CH-46 was hit by a MANPADS. The objective of this project is to evaluate the effectiveness of fire-reduction technologies for pressurized fuel lines that can be easily retrofitted to fielded aircraft. Five different passive fire reduction and suppression technologies were evaluated alone and/or in combination. Candidate technologies included dry-bay foam, self-healing plastic sheets, and a low-cost, lightweight, commercial off-the-shelf (COTS) fire detection and extinguishing system known as the Firetrace Indirect Extinguishing system. Threats tested ranged from 7.62 mm armor piercing incendiary to 23 mm high explosive incendiary. The final report should be available through the Defense Technical Information Center by the end of 2009.

H-60 Dry Bay Compartment Fire Protection and Vulnerability Test. Results from the Joint Army/Navy H-60 helicopter ballistic vulnerability LFT&E program identified concerns in the transition section of the aircraft, above and behind the main fuel cells. The H-60 series of helicopters do not have fire detection and suppression systems for these regions. The objective of this test program is to provide additional insight into these vulnerabilities and to demonstrate a potential hardware solution. Testing used the results from the JLF-Air CH-46 fuel line testing project. Some additional testing specific to the transition section of this platform was conducted. The testing concentrated on a low-cost, lightweight, COTS fire detection and extinguishing system known as the Firetrace Indirect Extinguishing system. This system proved very successful in the CH-46 testing and illustrates a potential solution to reduce fire vulnerability. Post-test results will be provided to the U.S. Army Utility Helicopter Program Office, U.S. Navy PMA-299 MH-60R/S Multi-Mission Helicopter Program Office, and other organizations as appropriate. Testing completed in FY09 and the final test report will be released per JLF/AS guidelines during FY10.

F-404 Fuel Ingestion Characterization. The emphasis of this JLF/AS test project is to improve understanding of the fuel ingestion phenomenon, specifically, the dynamic internal engine pressures generated during a quick dump fuel ingestion event. A better understanding of this type of incident is needed to determine the magnitude of the overpressure events, and whether the overpressure is a localized or global event within the engine. This information is important for analyzing future engine vulnerabilities. There are two phases to this project, and each will evaluate a specific engine independently. The General

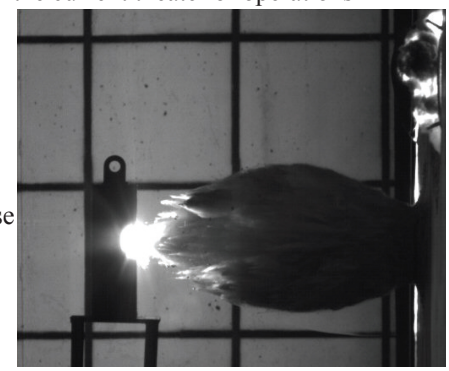
Electric F-404-GE-400 engine powers the F/A-18 A-D model aircraft and is the subject of Phase I. Phase II will evaluate the F-100-PW-100 engine, flown on the F-15 and F-16 aircraft. Phase I was used as a test specimen to collect time – pressure data, and to evaluate techniques to collect these data. The data will be passed on to Pratt & Whitney and the General Electric/ Fighter Engine Team to aide in their evaluation of their engines under the Joint Strike Fighter Live Fire Test. Test planning and execution began at the end of FY08 with testing completed in FY09. The final report should be available through Defense Technical Information Center early in FY10.

Large Engine Man-Portable Air Defense Systems (MANPADS) Vulnerability. The Department of Homeland Security (DHS) has also shown a great deal of interest in the vulnerability of large engines to the MANPADS threat. JLF/AS and DHS have partnered to test this vulnerability, with DHS providing matching funds to execute this testing. JLF/AS will shoot two MANPADS into functional CF6-50 aircraft engines. The engines are representative of those found on the A300, B747, and KC-10 aircraft. The project can also be a starting point for the LFT&E vulnerability analysis on the future KC-X acquisition program. This large turbofan engine project is a follow-on to a previous JLF project (T-04-02) that involved inert and live-warhead MANPADS impacts on a non-rotating TF39, C-5 aircraft engine. NASA will also be involved in this project using a combination of wind tunnel models and modeling and simulation to estimate the damage effects on aircraft safety of flight. This is an excellent example of inter-agency cooperation and leveraging of funds, which will go a long way in understanding the threat effects of MANPADS missiles and filling capability shortfalls in the JASP and JLF/AS MANPADS Roadmap. Test planning and coordination began in FY09 and testing is scheduled to proceed through FY12.

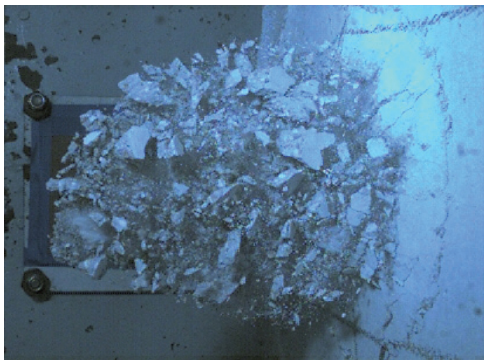
ARMOR/ANTI-ARMOR SYSTEMS PROGRAMS

The armor/anti-armor program seeks to fully characterize current threat weapons and munitions, providing critical empirical data to organizations such as the Joint Improvised Explosive Defeat Organization and the Joint Technical Coordinating Group for Munitions Effectiveness. The program also addresses combat helmet protection and survivability from weapons effects when traveling in tactical vehicles. The armor/anti-armor program continues to be instrumental in the understanding of weapons effects during Military Operations in Urban Terrain (MOUT) environments. Below are armor/anti-armor projects conducted during FY09.

Military Operations in Urban Terrain (MOUT) Weapon Effects of Emerging Threats Detonated Against Barriers. Testing of surrogate threats from the current theater of operations against several barrier configurations used by coalition forces for combat operation posts occurred in FY09. The tests investigated the mitigation/defeat of these threats through the use of high-performance concretes, air gaps, Hercules Engineering Solutions Consortium Bastions, and multiple barrier assemblies. The 2009 JLF MOUT program continued to investigate weapons effects using barriers made of high-performance concrete. A direct comparison of effects against this material and effects against conventional strength concrete are being performed for some of the threat/ target pairings.

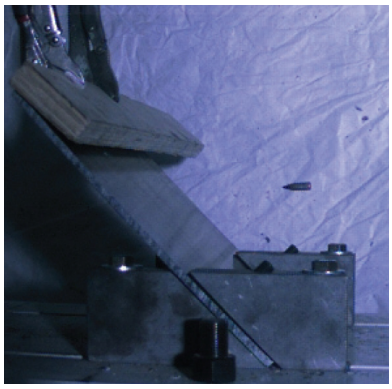


Testing to Collect Data in Support of Expanded Fast Air Target Encounter Penetration (FATEPEN) Modeling Capability. JLF completed testing to gather data to expand the capability of the engineering penetration and damage model FATEPEN. FATEPEN is used to model fragments generated from fragmenting warheads striking concrete targets. This testing is focused on refined debris collection for concrete targets reinforced at various locations. FATEPEN is utilized by both the JTCG/ME and JASP for the analysis of fragmenting warheads.



Venting Effects on Quasi-static Pressure. Current Vulnerability/ Lethality models inaccurately predict the structural response of urban targets when subjected to munition attacks. One possible reason may be the inaccurate prediction of quasi-static pressure. The objective of this FY09 JLF program was to determine a relationship between structural venting and quasi-static pressure levels. To ensure the relationship was neither facility, nor charge weight dependent, two structures and multiple charge

sizes were used. The Air Force Research Laboratory performed evaluations at the Reusable Target at Eglin Air Force Base. The Army Research Laboratory performed evaluations at the two-room blast structure at Aberdeen Proving Ground. The data obtained will be used to improve current methods for predicting weapon effects during Military Operations in Urban Terrain.



Testing to Collect Data in Support of Projectile Penetration (ProjPen) Modeling Capability. JLF completed testing to gather data for small caliber projectiles striking multiple metallic plates. Testing focused on the residual properties of the projectiles. This testing will provide a greater understanding of projectile penetration through realistic targets. ProjPen is utilized by both the JTCG/ME and JASP for the analysis of small caliber projectiles.

External Blast - Full Vehicle Blast Data and Validation. Testing in FY09 was conducted to assess the vulnerability of towed and portable generators, a towed howitzer (T12), a towed gun system (KS-19), a radar van, and a light observation helicopter (OH-58) to external air-blast loads. Testers detonated bare explosive spheres at various positions and made careful assessments of the resulting blast damage. Instrumentation characterized the applied air-blast load to the target. Engineers then analyzed the data to develop lethal miss distance contours (the distance from a detonation that a person or equipment must be to survive) with respect to mobility, firepower, and catastrophic target kills.

Arena Testing Methodology Improvements. The proper evaluation of the lethality of a weapon against a target requires accurate characterization of the lethal effects of its warhead. This study assessed the state-of-the-art of warhead arena testing. The study also investigated the possible benefits of new technologies and concluded by making a series of recommendations. First among these recommendations is to augment warhead arena testing with predictive analysis. This will both lower the cost and improve the quality of warhead characterization. The study also recommended a new medium for capturing the fragments produced in these arena tests. This will improve the accuracy of the fragment recovery process and lower the test cost.

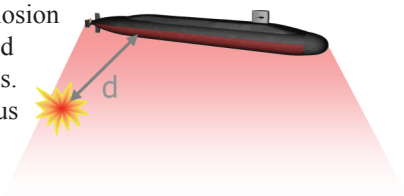
SEA SYSTEMS PROGRAM

The JLF/SS made significant progress in 2009 toward assessing the survivability of submarines and surface ships. Examples of these efforts are discussed below.

Finnish Fast Attack Craft Testing. In 2009, a multi-year, trilateral (US, Finland, Germany) cooperative effort was initiated to perform damage testing against two aluminum, decommissioned Finnish fast attack craft. The Finnish Navy is providing the boats, and has conducted testing on their test range; the German and U.S. Navies are providing instrumentation, test planning, and analysis. The objective is to understand the behavior of aluminum structures subjected to various weapon effects; the ongoing validation of analytical tools for these applications is a primary objective.

Network Fire Model Enhancements. This project provided funds to the Naval Research Laboratory (NRL) to further develop the Fire and Smoke Simulator (FSSIM). This investment allowed the incorporation of non-traditional Navy ship structural materials, such as aluminum, into FSSIM models. The enhanced model was used to assess the structure of the Joint High Speed Vessel. The model can be used by engineers to develop designs that limit the spread of smoke and fire. The FSSIM enhanced model is available to ship designers through the NRL.

Submarine Susceptibility to Mines. This project is improving the ability to assess the susceptibility and vulnerability of submarines to threat mines through testing and analysis. In August 2009, small-scale testing was initiated for the purpose of advancing underwater explosion vulnerability analyses based on susceptible engagements. Remaining efforts will focus on understanding the data, validating analyses, and constructing relevant engagement scenarios for vulnerability analyses.



Full Ship Shock Trial (FSST) Cost Reduction Study. This study investigated the costs associated with the planning and execution of FSSTs. It also explored options to conduct FSSTs at a cost of no more than $15 Million. The effort based its findings on an in-depth study of the most recent FSSTs: the LPD-19 (2008) and the DDG 81 (2001).

SPECIAL PROGRAMS

The JTCG/ME, JASP, and JLF programs are formal programs funded by DOT&E. In addition to these programs and DOT&E's statutory oversight responsibilities, DOT&E participates in focused initiatives that directly support warfighters deployed to OEF/OIF, and/or address issues of significant importance to the Congress. Four of these efforts are described in the Special Programs section.

Personnel Protection Equipment. DOT&E continued oversight of personnel protection equipment testing. DOT&E and the Army provided an interim report to Congress in October 2008, on testing completed to support PEO - Soldier's source selection process for hard body armor. Subsequently, the Army Test and Evaluation Command (ATEC) completed First Article Testing (FAT) in February 2009 and follow-on Lot Acceptance Testing (LAT) on material submitted for government purchase. Concurrent with those LATs, ATEC initiated a second phase of extended ballistic testing in February 2009, to characterize rigorously the performance of plates that passed FAT and LAT. Phase II results are also helping DOT&E, in partnership with the Services and the U.S. Special Operations Command, to develop a new hard body armor testing protocol. ATEC completed Phase II testing in October 2009 and expects to complete their report in mid-January 2010. DOT&E will prepare an independent report of the Phase II testing.

The DoD Inspector General (IG) published a report in January 2009, which focused on testing overseen by PEO - Soldier prior to 2007. The DoD IG indicated inconsistencies in First Article and Lot Acceptance tests that questioned the performance of some hard body armor plates in the Army's inventory. Though DOT&E did not agree with all of the DoD IG's findings related to FAT and LAT efforts, DOT&E did agree with the DoD IG that government oversight of testing should be increased and that DOT&E should prepare a DoD-wide standard for body armor ballistic inserts. Subsequently, the Army transferred responsibility for all hard body armor testing to ATEC. DOT&E is exercising oversight of that testing, and is in the process of preparing a DoD-wide standard for hard body armor testing.

The Government Accountability Office (GAO) published a report in October 2009, indicating that Army testers did not consistently follow appropriate testing procedures during the previously mentioned testing conducted by ATEC. The GAO indicated that the Department cannot be assured that the capability of body armor plates procured by the government and tested by ATEC will protect against threats they are designed to defeat. Although the DoD did not agree with some of GAO's conclusions, the DoD agreed that inconsistencies in testing did occur. To address the GAO's recommendations, DOT&E commissioned the National Academy of Sciences to conduct an independent review of tests conducted at Aberdeen Test Center that were the subject of the GAO review. The review is broad in scope and the Academy is asked to provide recommendations on how to best test hard body armor. A final report will be completed in early 2011. An interim report will be provided in early January 2010 providing recommendations on the use of the laser measuring instruments and clay backing material used in body armor testing.

Enhanced Combat Helmet. During FY09, the U.S. Marine Corps and the Army invited DOT&E participation on their joint effort to rapidly develop and field an enhanced combat helmet. This program seeks to increase ballistic protection for warfighters while maintaining weight equivalent to the Army's currently fielded Advanced Combat Helmet. The Services have made significant progress on a very technically challenging effort. Testing against developmental models of helmets will continue into FY10.

Active Protection Systems (APS). In response to FY08 legislation, DOT&E continues to direct and oversee testing of active protection systems with the potential of protecting wheeled tactical vehicles, especially light wheeled tactical vehicles. Presently six manufacturers are participating in this program. Efforts to include international vendors have been successful. Testing will continue through FY10. Upon completion, DOT&E will provide a report to the Congress.

Non-Lethal Weapons (NLW) Test and Evaluation. In response to FY07 legislation, DOT&E continues its involvement with the Joint Non-Lethal Weapons Directorate and the Service force protection equipment and NLW program managers. DOT&E published its "Policy for Operational Test and Evaluation and Survivability Testing of Force Protection Equipment and Non-Lethal Weapons" via memorandum in September 2008. This policy established the Services' responsibility in meeting the DOT&E policy and defined DOT&E's goals for complying with the legislative requirement.