Survivability

The threat of man-portable air defense systems (MANPADS) to civilian aircraft has increased significantly during the past few years and in 2004 gained greater attention as a cheap and potentially effective way to carry out terrorist acts. This year the Transportation Security Administration began to fund the demonstration of countermeasures to protect an aircraft from MANPADS threats during the vulnerable periods of takeoff and landing.

The FAA, NASA, and the Air Force are currently examining three systems that use sensors to detect a missile after launch, track the projectile, and point a laser beam of infrared energy at it to interfere with its tracking mechanism, steering it off course. Under the current timetable, the earliest deployment of such a system aboard airplanes will be in 2006.

Alternative approaches for reducing the MANPADS threat are being explored for near-term application to aircraft operating in the low-altitude, slow-speed operating environment. Operational records indicate that an aircraft being hit with either a MANPADS or a rocket propelled grenade (RPG) does not necessarily equate to an aircraft loss. Efforts to understand and exploit the conditions that contribute to an aircraft surviving a MANPADS/RPG hit are producing results of value for military as well as commercial aviation.

This DHL freight Airbus A300 was hit by a missile, probably a SAM-7, seconds after taking off from Baghdad Airport in late November 2003. The plane is shown here shortly after its emergency landing at the same airport.

These activities are focused on developing evasive avoidance of the munitions, design tolerance of flight-critical subsystems to structural damage, and flight-critical subsystem adaptation to the damage in order to permit continued flight. Examples of these efforts include improving tactics for aircrew avoidance of a MANPADS/RPG impact; using modeling and simulation as well as test and evaluation capabilities to predict aircraft performance effects resulting from a MANPADS/RPG impact; and quantifying the effectiveness of modifying an aircraft's infrared (IR) signature to draw an incoming IR missile away from flight-critical components.

Defining and reducing the vulnerability of military transport aircraft to ballistic threats has also been a major area of focus this year. The Air Force RDT&E community is exploring a variety of potential survivability improvements for the C-130, C-17, and C-5 aircraft through advanced modeling and test techniques. Test efforts incorporating both operational and simulated hardware use a high degree of realism, including external airflow, internal airflow, component temperatures, complex shapes, and representative loading. These aircraft received subsystem evaluations in the areas of engine nacelle and fuel tank fire extinguishing system performance against ballistic-induced fires; vulnerability assessment of major airframe subsystems made of high-strength composites and metals; and evaluation of damaged flight control structures and operating mechanisms to assess mission capability.

Exploration and understanding of the F-35's vulnerability against ballistic threats was the primary focus of fighter-related efforts by the USAF. Design alternatives were explored for their application to an aircraft such as the Joint Strike Fighter. Areas of concentration included internal fuel tank and dry bay firefighting systems; ballistic projectile impact-tolerant materials; and windshield system projectile impact response.

This was also a year for improving the survivability of the space shuttle in the face of launch debris as well as terrestrial and orbital debris dangers. Following the loss of Columbia to foam impacts on its thermal protection system (TPS) in 2003, NASA teams spent considerable "down time" this year improving the foam design of the shuttle's external tank and refining their understanding of TPS failure modes. The agency also focused substantial effort on examining and improving its meteoroid/orbital debris assessment methodology for shuttle TPS materials. Other areas receiving high priority and increased attention following the loss of Columbia included methods and designs for safe crew return in case of shuttle TPS failure on ascent or on orbit, and TPS repair techniques.

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