MANPADS Countermeasures:

flares, infrared beams and computer software

For a few years, in the aftermath of incidents in Baghdad and Mombasa, the industry became overtly concerned that terrorists might try to bring down commercial aircraft using man-portable air defence systems (MANPADS) or rocket propelled grenades. Anna Costin investigates the technological options available to safeguard aircraft against such a method of attack.

MANPADS (Man-Portable Aircraft Defence Systems) are lightweight, guided surface-to-air missiles (SAMs). They are on average five feet long and weigh13-18 kilograms. Depending on their type, MANPADS can engage aircraft between three and seven kilometres away and can reach altitudes of 10,000 to 15,000 feet above their launch point - although this is dependent upon the target's bearing to the launcher, and its aspect. While MANPADS ranges are modest compared to larger missile systems, they are large enough to pose a threat to the safety of aircraft taking off or landing. MANPADS are heat seeking and a commercial aircraft has several heat sources for the missile to track, including engines, power units, air conditioning units and lighting.

There are an estimated 500,000 MANPADS in the world today, many thousands of which are thought to be available on the black market and therefore accessible to terrorists and other non-state actors; they can cost as little as a few hundred dollars to buy. In August 2010, a report by the Federation of American Scientists (FAS) stated that "only a handful" of illicit MANPADS were recovered from terrorist caches in Iraq in 2009. Because MANPADS are shoulder-launched, they can be confused with weapons such as Rocket Propelled Grenades (RPGs). These are shoulder launched unguided rockets and have a high explosive or anti-armour warhead designed to destroy vehicles. As they offer only modest accuracy over a range of a few hundred metres, they would have minimal effect on a rapidly-moving large target such as a jet aircraft on takeoff or landing.

In the mid-2000s, the MANPADS threat to civil aviation and the need for


Credit: Northrop Grumman

countermeasures was a central issue for governments, manufacturers and the aviation industry. This was due to the attempted downing by militants of an Arkia Israel Airlines plane over Mombasa in 2002 and of a DHL cargo plane over Baghdad in 2003. In 2003, Thai authorities intercepted a plot by the Jemmah Islamiyya group to down an El Al jet taking off or landing from Bangkok International Airport and in 2005, Swiss authorities foiled a similar plot by a North African cell of al-Qaeda to down an El Al jet with a rocket over Geneva.

Millions of dollars have been spent on research programmes, evaluating the cost-benefits of installing MANPADS countermeasures on commercial craft and some countries – notably Israel – did install the technology on some of its planes.

In 2004, Israel implemented the Flight Guard aircraft defence system on some of the craft of its national carrier El Al that fly to high risk destinations. However, several European countries and the US Federal Aviation Authority banned any craft with Flight Guard installed from their airspace due to fire safety hazard concerns as the system uses flares, which could start fires on the ground when deployed and cause public alarm. The military, flying in combat zones, uses flares as they are in theatres of war where fires on the ground are not viewed as a hazard. Furthermore, military aircraft can carry out aerobatic manoeuvres to avoid being hit by missiles, unlike commercial jets. Flight Guard was scrapped after having been installed on only a handful of the El Al fleet due to both the international regulatory constraints and for financial reasons; it was a very costly system. The UK did permit the system, and Heathrow Airport was considered as one of the highest risk airports by Israeli security services. Security was stepped up around Heathrow in February 2003 after intelligence reports stated that al-Qaeda was planning to imminently shoot-down a jet over the airport.

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Saab Avitronics, Chemring Countermeasures and Naturelink Aviation have developed CAMPS (Civil Aircraft Missile Protection System), a flare-based infrared system developed specifically for civil aviation. It uses a pyrophoric substance that burns at a relatively low temperature, unlike conventional military flare-based systems, thereby avoiding fire safety concerns on the ground. CAMPS has been designed to protect civilian aircraft flying under 15,000 feet. However, aside from the safety concerns over the use of flare based countermeasures and their cost, flare-based systems have minimal effect against the latest generation of MANPADS and are subject to high incidences of false alarms.

In 2008, Israel procured a laser-based jamming system called Multi-spectral Infrared Countermeasure (MUSIC) that does not use flares and in 2009 it was reported in the press that the Israeli transport ministry had awarded Elbit Systems a $76 million contract to supply this system, as part of the government's Sky Shield aviation defence plan, to protect aircraft from MANPADS. MUSIC will reportedly be installed on all El Al, Arkia and Israir planes.

Outside of Israel (whose aviation industry has for decades been high risk for terrorist attacks), current thinking has moved away from the critical need to install MANPADS countermeasures on commercial aircraft. Air Safety Week reported in November 2010 that a declassified US Department of Homeland Security (DHS) report found that fitting the roughly 3,600 large US-registered commercial aircraft with MANPADS countermeasures would cost $43.3 billion over 20 years. The report was commissioned by the US government to determine the cost and benefits of adapting military aircraft missile defence systems to civil aviation. Not only is the cost exorbitant, but the DHS found there was no credible intelligence about planned MANPADS attacks against US commercial planes. The report was the result of an eight year $276 million research project

Notable Use of MANPADS Against Civil Aviation

- 1978 Air Rhodesia: The pilot of the aircraft made a controlled crash landing, but 10 survivors were killed by ZIPRA guerillas.
- 1979 Air Rhodesia Flight 827: Shot down by ZIPRA guerillas armed with a Strela 2 missile. All 59 passengers and crew were killed.
- 1993 Transair Georgian Airline: Two aircraft were shot down a day apart in Sukhumi, Abkhazia, Georgia, killing 108 people.
- 1998 Lionair Flight LN 602: On 7 October 1998, Tamil Tigers shot down an aircraft off the coast of Sri Lanka.
- 2002 Mombasa attack: On 28 November 2002, two shoulder-launched Strela 2 (SA-7) surface-to-air missiles were fired at an Arkia Israel Airlines Boeing 757 as it took off from Moi International Airport. The missiles missed the aircraft which continued safely to Tel Aviv.
- 2003 Baghdad: On 22 November 2003, an Airbus A300 cargo plane, operating on behalf of DHL, was hit by an SA-7 missile, which resulted in the loss of its hydraulic systems. The three man crew landed the aircraft by using differential engine thrust and escaping injury.
- 2007 Mogadishu: On 23 March 2007, a TransAVIAexport Airlines Ilyushin Il-76 craft crashed on the outskirts of Mogadishu during the 2007 Battle of Mogadishu. Witnesses claim that a surface-to-air missile was fired immediately prior to the accident but Somali officials deny that the plane was shot down.

into evaluating airborne and ground methods of protecting civil aircraft from MANPADS.

The DHS Science and Technology Directorate (DHS S&T) adapted Directed Infrared Countermeasures (DIRCM) technologies (which jam missile guidance systems through infrared technology) made by Northrop Grumman and BAE Systems and tested their operational suitability for commercial aircraft. BAE fitted its JETEYE system on three Boeing 767-200 planes and Northrop Grumman fitted Guardian missile defence systems on 16 MD-10 cargo planes. DHS declared the DIRCM technology effective but that it did not meet reliability requirements in terms of equipment failures, leading to increased maintenance costs. DIRCM requires repair or refurbishment after approximately 300 hours operational use; a requirement the military can meet but not commercial aviation, whose aircraft operate on average 10 to 12 hours per day. The DHS report concluded that the cost of adapting current missile countermeasures technologies to protect civil aviation planes would be at considerable cost and impact on airline operations.

DHS S&T also evaluated Emerging Counter-MANPADS Technologies (ECMT). One airborne and two ground-based systems using non-DIRCM technology were evaluated. In 2006, DHS awarded $7.4 million in contracts to L-3 Communications' AVISYS subsidiary, Northrop Grumman and Raytheon to assess ECMT suitability for commercial aviation. The DHS report found that the ECMT technology had technical and safety deficiencies that would have to be addressed before any commercial deployment of the systems. DHS also launched Project CHLOE to evaluate persistent high-altitude standoff protection of commercial aircraft using unmanned aerial vehicles, to protect airliners up to 65 miles from airports. The conclusion of the project found that although this technology could detect and track MANPADS it was not able to effectively defeat them.

The DHL cargo plane hit over Baghdad Airport in 2003

Matt Schroeder, Manager of the Federation of American Scientists' arms sales monitoring project says, "the need to protect jetliners against such portable weapons is indisputable, but the question remains how best to do it."

"...the military, flying in combat zones, uses flares as they are in theatres of war where fires on the ground are not viewed as a hazard..."

As the DHS report stated, no credible MANPADS attacks threats against civil aviation were found, and furthermore, whether an actual MANPADS attack had the ability to effectively shoot-down or destroy a civil airliner is questionable; the Mombasa and Baghdad attacks both failed (the DHL plane successfully landed in Baghdad and the Arkia flight continued to Israel without problem) in their mission. MANPADS have successfully shot down military helicopters in conflict zones, but helicopters are much smaller, lighter and more vulnerable to attack.

In 2006, the US Airline Pilots Association (ALPA) wrote a security briefing on MANPADS countermeasures. Their paper suggested that instead of focussing on countermeasures technology, aircraft themselves could be hardened to attacks. They stated that large aircraft have a statistically high chance of surviving damage

sustained by a MANPADS attack but not a 100% chance. Therefore, design improvements could be made to improve the chance of survival, such as the inclusion of redundant backup control systems to maintain control of the craft following a loss of primary flight function. Such systems include the Propulsion-Controlled Aircraft system and hydraulic fuse plugs. Aircraft could also be better protected through the implementation of fuel shut-off valves and improved fire and explosion suppression systems.

The ALPA briefing also stated that MANPADS countermeasures may not provide effective defence against other standoff weapons. ALPA states the biggest current 'weapon' threat to commercial aviation is not MANPADS but lasers; laser attacks, where laser beams are shone into the flight deck of craft, potentially blinding pilots, are on the increase. These have not been carried out by terrorists but by irresponsible individuals for non-terrorist reasons, or have been caused by lasers at entertainment shows crossing paths with low-flying aircraft on take-off or landing.

Another countermeasure is the use of software to identify potential MANPADS launch sites around airports and airfields. Cunning Running Software Ltd. has developed the Surface to Air Missile Position Ranking and Analysis System (SAM-PRAS). It uses flight path, terrain and weapon data. It is currently being rolled out to regional airports in the UK and US. Rontal, in Israel, developed a similar product by the name of AirGuard; Rontal Applications Ltd. was sold to Verint Systems Inc. in March this year.

Another measure, already being implemented inter-governmentally, is the pursuance of agreements for the non-proliferation of MANPADS. The international community is acting to improve stockpile security and strengthen export controls in countries that import and manufacture MANPADS through various initiatives including the G8 2003 Action Plan, the Wassenaar Arrangements and the Organisation for Security Cooperation in Europe's decision in 2003 on the non-proliferation of MANPADS. Such initiatives are important to ensure that protective systems being developed for aircraft today are not made obsolete by terrorists acquiring the next generation MANPADS tomorrow.

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In conclusion, the MANPADS threat to commercial aviation is real but not critical and the risk of destruction or significant damage to an aircraft is relatively low. Commercial aircraft design should include measures to harden planes to the consequences of possible attacks. When effective, reliable and affordable MANPADS countermeasures become available, they should be considered for installation on commercial carriers, but, as the International Federation of Airline Pilots Associations (IFALPA) has said, as the MANPADS threat is a threat to national security, and not the airline industry itself, the cost should be borne by governments. ■