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Shoulder-fired missiles and civil aviation : the U.S. response to a "new" terrorist threat

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Recent events have drawn attention to the threat that shoulder-fired weapons may pose to commercial aircraft. In November 2002, for example, terrorists fired two SA-7 Surface-to-Air missiles (SAMs) at an Israeli airliner departing Mombassa, Kenya. Law enforcement officials have also recently arrested people in Hong Kong and New York who were trying to illegally sell shoulder-fired missiles. Policy makers in the United States are currently trying to precisely quantify how extensive this threat is, and to weigh the pros and cons of various threat mitigation strategies.

A growing risk for passenger airplanes

Shoulder-fired SAMs are approximately 1.50 meters long, 8 cm in diameter, and weigh between 5 and 15 kg. Shoulder-fired SAMs are effective up to about 15,000 feet (c. 4,500 meters) in altitude, and approximately 6 km in range. Thus, while airliners are safe from these SAMs when flying at cruising altitudes (i.e., above 18,000 ft. or 5,500 meters), they are vulnerable when taking off and landing.

Shoulder-fired SAMs are frequently called heat seeking missiles because many of them employ sensors that home in on the target's hot infrared (IR) signature, often the engine. A significant feature of IR guided missiles is that they do not emit detectable energy that can warn targeted aircraft. Not all shoulder-fired missiles are IR guided however. Britain and Sweden make shoulder-fired missiles (e.g. *Blowpipe* and RBS-70) that employ laser or radio frequency guidance. They too

[1] The views reflected in this paper are not necessarily those of the *Congressional Research Service*, nor the United States Government.

are extremely hard to detect once launched. Radar-guided SAMs, in contrast, are easy to detect once an aircraft is targeted.

Estimates of the global inventory of shoulder-fired SAMs range from 350,000 to 750,000 units, and at least 13 different countries manufacture these weapons. Quantifying which countries own shoulder-fired SAMs is relatively easy. Determining the number of terrorist groups that own shoulder-fired missiles, on the other hand, is understandably difficult. Some estimate that 27 militia groups and terrorist organizations own shoulder-fired SAMs. However, policy makers are likely approaching this issue with the assumption that all major terrorist groups, and certainly well financed ones like *al Qaeda*, own these weapons. Their low cost – between 5,000 and 30,000 U.S. dollars on the black market – small size, global distribution, and simplicity make shoulder-fired SAMs particularly accessible and attractive to terrorists.

Over the past 25 years, 35 civilian-use aircraft were targeted in shoulder-fired missile attacks, resulting in 24 aircraft being shot down. Most of these attacks took place in war torn regions of the world. Of these attacks, 5 involved large jet airliners, two of which were destroyed killing all on board. These past incidents suggest that the likelihood of a civilian aircraft surviving a missile attack is quite low, only about 30%. The most recent missile attack against a jet airliner was the 19 November 2002 failed attempt to shoot down an Israeli Boeing 767 in Mombassa, Kenya. While the threat of shoulder-fired missiles to commercial aircraft has long been recognized by aviation security experts, this incident has focused the attention of policymakers in the United States on mitigation options.

Current mitigation strategies in the United States

A variety of mitigation strategies are being considered including: protecting the aircraft, especially with missile countermeasures; conducting threat assessments and implementing security measures at airports and under flight paths; implementing arms control policy initiatives and trying to control the black market for these weapons. There are no ready solutions for reducing the risk through flight operational procedures.

Protecting the aircraft

Research to date examining ways to improve the survivability of civil aircraft has focused on the threat of internal bomb detonations. Thus, little is known about what damage is likely to result from a shoulder-fired missile attack and what can be done to improve the odds of surviving such an attack. For instance, aircraft hardening has not yet been looked into and is not a near term option for mitigating the risk.

Also, aviation experts do not consider training pilots to make evasive maneuvers to be an advisable mitigation strategy. Even if a pilot were given adequate warning, large jetliners are not maneuverable enough to get out of the way of a fast moving missile. Moreover, trying to do so may result in losing control of the airplane or could place enough stress on the airframe to cause a catastrophic structural failure. Highly trained pilots have the best chance of surviving a missile

strike by relying on their extensive training and procedures to handle a post attack emergency. The potential benefit of providing additional pilot training for handling missile attack scenarios remains to be evaluated.

More promising are aircraft-based countermeasures, of which there are two main types. Infrared countermeasures (IRCMs) consist of flares[2] that the plane will eject in the direction of the missile to try and make it change its course. The most likely IRCMs to be considered are the modern fire-resistant type, which will not set fire to the densely populated areas it may eventually fall upon. The other kind of aircraft-based countermeasures is lasers, often called DIRCMs (directed IR countermeasures), that try to blind the missile guidance sensors.

Both approaches need a reliable missile approach warning systems (MAWs), to determine that a shoulder-fired missiles has been launched. Little bursts of light, heat or fire that are frequent in a city surrounding an airport can easily set off the MAWs. Telling real missile attacks from false-alarms may be a key challenge to these systems' effectiveness.

One proposal presented to U.S. policymakers for consideration would require U.S. airlines to equip their jet-powered airplanes with suitable anti-missile devices purchased by the U.S. government. Presently, the U.S. appears to be moving forward with a less ambitious program for the time being that will examine this mitigation alternative in detail. The current plan consists of an engineering development, test, and evaluation program to identify and certify a suitable anti-missile system for commercial aircraft. Sixty million USD have been appropriated for the first year of this project, which is anticipated to last two years and total 100 million USD. If, at that time, the United States elects to go forward with installing this equipment on civilian airliners, it is expected to cost between 1 million USD and 3 million USD per airplane to do so. Besides the United States, only the Israelis appear to be actively pursuing the option of aircraft-based countermeasure systems for use on civilian aircraft.

Patrolling airports and flight paths

Aviation security officials have been conducting threat assessments in U.S. busiest airports and, in cooperation with international authorities, at selected airports around the world. However, providing physical security and surveillance to protect flight corridors leading to and from airports based on the findings of these assessments is a daunting task. The flight profiles of large commercial airliners leaves them vulnerable to shoulder-fired missiles for considerable distances beyond the airport perimeter. Commercial airliners typically operate below 15,000 feet (about 4600 meters) for about 50 kilometers after takeoff, and as far away 80 kilometers during approach and landing. Modifying air traffic control procedures to reduce the vulnerability of arriving and departing aircraft is not a particularly practical mitigation strategy. The performance capabilities of large jet airliners do not lend themselves to appreciable changes in climb or descent gradients. Also, low altitude maneuvering; such as steep spiral descents may compromise safety and passenger comfort.

[2] *Leurres thermiques.*

Providing sufficient security to adequately deter terrorists from setting up and launching a shoulder-fired missile from a position under one of these flight paths is also a significant challenge. One proposal recommends deploying the National Guard and the U.S. Coast Guard to protect airliners operating within the United States from the shoulder-fired missile threat until all jet airliners can be equipped with aircraft-based missile countermeasures systems. Other options include increasing police patrols under flight paths and increasing citizen awareness and vigilance for suspicious activities under flight paths. Various surveillance techniques including airport perimeter surveillance and low-altitude aerial patrols along flight corridors may also provide some deterrence. However, given the size of the area to be defended, no single strategy can offer a high degree of protection unless significant resources are devoted to such an effort.

Fielding ground-based interceptors near airports is another option that has been suggested. These interceptors could be vehicle-mounted SAMs, or even directed energy weapons like the Army's tactical high-energy laser (THEL). Cost, reliability, probability of intercept, and potential unintended consequences (e.g. falling debris, or inadvertently shooting down a commercial aircraft) would have to be weighed when considering these options.

Controlling exports and the black market

Lastly, there is currently no multilateral arms control regime designed to stem the proliferation of shoulder-fired missiles. The Wassenaar Agreement attempts to provide transparency among it members on the export of conventional weapons, but currently has no sanctions and does not include all exporters of shoulder-fired SAMs. All export control is currently achieved on a country-by-country basis.

The International Civil Aviation Organization (ICAO) is presently seeking to establish an international anti-proliferation convention and methods to track these weapons. While such efforts may help to thwart the continued proliferation of existing shoulder-fired missiles; these weapons are already widely proliferated and are reported to be easily available on the black market.

The United States has focused a considerable amount of its intelligence and law enforcement efforts on this threat toward infiltrating the black market for shoulder-fired missiles. Over the past two years, the Federal Bureau of Investigation (FBI) has been involved in two high profile sting operations involving sales of shoulder-fired missiles. First, FBI agents posing as illicit arms dealers nabbed three suspected *al Qaeda* operatives attempting to purchase shoulder-fired missiles in Hong Kong last year. More recently, the FBI allied with Russian investigators to catch a New York black market arms broker, who was allegedly willing to serve as a middle-man in a deal to smuggle large numbers of Russian-made shoulder-fired missiles into the United States. Covert intelligence and law enforcement operations such as these are likely to remain an important component of the U.S. strategy for combating the risk of a shoulder-fired missile attack.

Presently, the United States Department of Defense is also focusing its efforts to reverse the widespread proliferation of shoulder-fired missiles on recovering these weapons from non-State entities in Afghanistan and Iraq through "buy-back" programs.

A continuing threat in the forthcoming years

Shoulder-fired missiles are highly proliferated and are readily available to terrorist organizations. Past experience demonstrates that shoulder-fired missiles present a significant risk to civil aircraft. Last year's attempted shooting of an Israeli jet airliner in Kenya indicated that terrorist groups were capable and motivated to launch such an attack and served to focus the attention of policy makers in the United States. While there are a number of strategies that can be considered to mitigate the risk to civil aircraft posed by shoulder-fired missiles, no single strategy can offer both a readily available and highly effective deterrent.

Presently, the United States is moving forward with plans to study the utility of aircraft-based missile countermeasures as a possible long-term mitigation strategy. While a variety of aircraft-based systems exist, laser-based systems similar to those being installed on military transport aircraft appear to be leading contenders for a more detailed evaluation of their capabilities to protect civilian jet airliners. In the meantime, the United States is conducting threat assessments at busy airports, while the intelligence community and federal law enforcement agencies have carried out covert operations to infiltrate the black market for these weapons.

The shoulder-fired missile threat to civil aviation is likely to be a continuing challenge for policymakers in the United States and a variety of mitigation strategies including technologies, aviation security procedures, flight operational procedures, and intelligence and law enforcement operations may be considered to address this threat.