THE MANPAD THREAT TO COMMERCIAL AIRCRAFT

Nick Hock, Mark Richardson[1], Brian Butters, Roy Walmsley, Richard Ayling, and Bill Taylor

Abstract: The man-portable air-defence (MANPAD) missile threat for non-countermeasure equipped commercial aircraft is high during approach and departure. Modelling reported here has shown for one particular type of missile, the SA-7b, that the threat can be minimized if a Spiral Approach is used. Since the spiral is flown offset to the airport, it is recommended that the first turn be away from high threat areas to ensure most of the approach is over lower threat zones. The SA-7b was more successful against aircraft on departure compared to on approach. Evasive manoeuvres during departure are limited and thus rate of climb should be maximized, which can be done by reducing fuel and/or take-off weight. Threat area footprints were developed to determine the MANPAD danger areas an aircraft is exposed to when using a high threat airport. The Spiral Approach and Standard Departure footprint was the smallest and contains much of the area occupied by the airport, which most likely is already secured. Therefore this combination is recommended for use for civilian aircraft when a MANPAD threat is present.

INTRODUCTION

Due to the current and ongoing international instability, the threat of future surface-to-air missile (SAM) attacks on commercial aircraft is real. Stop-gap measures to protect aircraft against man-portable air-defence (MANPAD) missile threats need to be evaluated until commercially viable systems are developed, tested and installed.

MANPADS

MANPADS are shoulder-fired SAMs designed to be the lowest level of air defence for ground units. Although current MANPADS have evolved into third-generation systems for modern militaries, first-generation systems are still of considerable threat to military and civilian air traffic. Legacy systems such as the SA-7b have been out of production for decades, but they can still easily be re-manufactured in a number of countries. The production numbers for all MANPADS is estimated to be around 500,000–700,000 [1] with many of these systems either produced by or provided to extremely unreliable groups. They are about 2 m in length, weigh about 15 to 18 kg and can easily be concealed in anything from a ski bag to a car or truck.

Generally MANPADS have a range of up to 8,000 m and a maximum altitude of around 4,000 m. Commercial aircraft fly much higher than this while on route and are therefore only exposed to the MANPAD threat during takeoff and landing. Under 6,500 m, a 16 km by 93 km area around an airport would have to be secured to ensure the approach and departure path was safe (25 nautical mile approach, 25 nautical mile departure path plus maximum MANPAD range at both ends).

Countermeasures

Although military countermeasure systems are quite mature, there have been extremely few examples of civilian aircraft being fitted with such systems. Estimated costs to install an IR countermeasure system on a commercial aircraft would be around US$1–3 million dollars per aircraft. The cost of equipping all the commercial US air traffic would therefore be from $6.6 billion to almost $20 billion. Installing a countermeasure system on a commercial aircraft would increase the drag of the airliner due to the addition of a pod or dome or require extensive airframe modifications. Although this drag might seem insignificant, it can, with the added weight of the system, increase the operating costs of an airline through added fuel costs [2].

CounterSim

Engagement scenarios for this paper were developed, modelled and simulated on CounterSim. Chemring Countermeasures of High Post, UK has developed this software for the study and evaluation of expendable countermeasures in the land, sea and air Electronic Warfare environments.

For this paper to remain at an unclassified level and hence to enable the greatest distribution of the results thus generated, classified SA-7b parameters were not sought for the CounterSim model but were instead found in open-source literature such as Jane’s [3]. A C-130 was used as the civilian heavy aircraft, as a model was readily available for CounterSim and the IR signature and structure of the C-130 is comparable to commercial airliners.

AIRCRAFT ON APPROACH

Standard Strategic Approach

Generally, all large strategic aircraft follow similar descent profiles, with the difference being the initial approach airspeed, which is 250 Knots Indicated Airspeed (KIAS) for a Canadian C-130 and 300 KIAS for an A-310 [4].

Steep Descent Approach

The Steep Descent Approach increases the descent rate of the approach and reduces the level off time and altitude. For this approach an initial descent rate of 1,000 m/min is used with an initial descent velocity of 160 KIAS. The aircraft is levelled off at 325 m, slowed to 130 KIAS and flaps and gear selected. Once intercepted, the 3-degree glide slope is then flown to touchdown. This procedure would reduce the length of the approach distance to 20 km compared to 45 km for the standard approach. The approach parameters meet heavy aircraft specifications, have a standard 3-degree final approach and are a simple, low-tech method of reducing the threat by MANPADS at hostile airports.

[1] Head Electro-optics Group, DAPS, Cranfield University, Royal Military College of Science, Shrivenham, UK.